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ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XIV. SECOND SERIES. JULY 1, 1803.

Specification of the Patent granted to WILLIAM SPEER, *of of the City of Dublin, Esquire; for an Improvement in the Construction of Hydrometers.*

Dated August 2, 1802.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Speer do hereby describe and ascertain the nature of my said invention and improvement, and the manner in which the same is to be performed, that is to say: I construct my hydrometer, as usual, of a ball, or hollow metallic part, to which is affixed a short stem with a load or weight, and diametrically opposite a longer stem for the purpose of graduation. The figures and dimensions of those several parts may be varied according to the well-known principles of this instrument; but the peculiar advantages of my improvement consists in the figure and method of graduating the stem; by means of which the gradations of strength of spirits at any known temperature can be seen, at once, by

by immersion of the instrument, without the necessity of changing weights, by trial, or making any computations, or refering to any tables or sliding-rule, or other instrument whatever. I accomplish these purposes by constructing the upper stem in the form of a polygonal prism, of such dimensions that the whole of the said stem shall float above the surface of the water, at the temperature of thirty-five degrees of the thermometer of Fahrenheit. And the surface of the water shall intersect the lowest line of graduation upon one of the faces of the prism. And upon the said face I mark lines of graduation at the several stations to which the instrument has been found to be immersed, and to float in known mixtures of water and ardent spirit, at different strengths, at the temperature of thirty-five degrees aforesaid, above or under proof, up to the strongest, which can be produced by distillation. And I mark the said graduations on the stem by numbers, denoting the ultimate results or strengths commonly known by the term *per centages*, which said results have heretofore been ascertained by computation instead of direct inspection, as is done by the instrument with my improvement. And farther, in explanation of the term *per centage*, I here observe, that a spirituous liquor is said to be ten *per cent.* or any other given quantity over hydrometer-proof, when it is so strong that one hundred gallons of the said spirit will admit of an addition of ten gallons of water to reduce it to the strength of proof, and it is said to be ten *per cent.* under proof when one hundred gallons of the spirit contains ten gallons more of water than the same quantity of proof-spirit contains. And, lastly, I engrave at the upper end of the said face, the figures 35, to denote that the graduations on that face of the prism are applicable to spirits at that temperature, or number of degrees.

And

And moreover, upon the next contiguous face of the prism, I form and apply, by the means aforesaid, a similar graduation for an higher temperature, such for example as the temperature of forty degrees. And again, upon the face or side next contiguous to the last-mentioned face or side, I form and apply a similar graduation for a still higher temperature, such for example as the temperature of fifty degrees; and in this manner I graduate the several faces of my stem, so that the face last graduated shall be applicable to the highest ordinary temperature, as for example seventy degrees. The number of sides of the polygon may be greater or less, according to the number of temperatures respectively, to which the determinations are required to be made; but I adopt and recommend eight sides as the best adapted for the general purposes of revenue and commerce, so that each side shall bear a scale of *per centages* of spirit, differing in temperature, by two degrees, namely, beginning at 35 degrees and ending at 70 degrees. And to prevent any error which might possibly arise from an unskilful operator reading off the strength upon a wrong face of the instrument, I apply to the stem a small index, which embraces the same, and can be slided upwards and downwards to any part thereof, so as to point at the proper division. This index, which is of a different colour from the stem itself, constitutes part of the weight of the instrument above the fluid, but it is by no means a trial weight, for it is put on from the indication of temperature before the instrument is immersed at all. And farther, although it is very easy, from the contiguity of the divided faces, for each temperature upon the eight-sided instrument to read the result for the intermediate temperatures to a degree of precision fully adequate to the purposes of revenue and trade; I do nevertheless

make and apply, as an addition to the said improved instrument, (to be used or not, at the pleasure of the operator,) two other indexes, which, being lighter than the first-mentioned index, do cause the instrument to shew the strengths at two equal intermediate temperatures between those marked upon any contiguous face of the general scale. Thus, for example, supposing the temperature fifty degrees, nothing further would be required but to place the index No. 1 on the side marked fifty, and immerse it in the fluid, of which it will at once shew the strength; but if the temperature be 51 or 52, I use the next lighter index, marked No. 2, which will cause the graduations to indicate strengths for the temperature $51\frac{1}{2}$; or in case the temperature had been 53 or 54, then the index No. 3 would have been to be applied, and the said face would then indicate strengths for the temperature $53\frac{1}{2}$, so that the result by the instrument will be true for the intermediate temperatures within half a degree; and even this small difference, if attended to, or thought of any importance, may be obtained by holding the jar containing the spirit a few moments in the hand.

And in the construction of an instrument for the immediate purposes of revenue and trade, I do recommend, and in practice, make the graduations on the stem to comprehend only those *per centages*, or strength, which are met with in the spirits usually dealt in in commerce, instead of beginning my graduations as low as water, near which strength no spirits are made or sold; or of carrying the said graduations up to the very highest alcohol, which is, comparatively, an article of little sale or transfer. By which means, I render my instrument more convenient, and the divisions more open and close. And with regard to the higher or lower strengths I would recommend another stem to be applied to the same

instrument,

instrument, as hereinafter described. And, lastly, in this my new improvement of the hydrometer, and the method of graduating the same, since I do not confine myself to the number of sides in the prism, or stem, but make them as numerous as the intended precision of experiment may require, I do also apply the same method of graduation to a cylindrical stem, which (as mathematicians well know,) may be considered as a prism, with an infinitely great number of sides. In this construction my lines of division, beginning from the lowest point, (as for water at thirty-five degrees), are passed obliquely upwards round the stem, and intersect certain straight lines drawn at equal distances from each other up the stem, which, by their intersection with the former oblique lines, afford certain points of graduation which answer to the several temperatures. And by this means, when the temperature is known, the immersion of the instrument will shew, by the intersection of the surface of the fluid, and one of the oblique lines on the very line of that known temperature, what may be the strength of the spirit. Or, otherwise, I make the stem of any figure whatever, of equal dimensions throughout its length, and instead of the flat sides of a prism, I divide the surface into longitudinal compartments by lines drawn lengthwise thereon. And I make my several scales of graduation as herein before described within. And upon the said several compartments, and in all the before mentioned constructions, wherein the same may be thought necessary, or desirable, with regard to the intermediate degrees, (instead of using different indexes as aforesaid) I alter the weight of the instrument, before immersion, by inserting four small pins in holes in the load or counterpoise below, or, if preferred, in the top of the upper stem, one of which pins being taken out

causes

causes the instrument to become lighter, for one of the intermediate degrees of temperature; and two of the said pins being taken out produce a change answerable to two degrees of temperature. Having as above described the use and application of my invention to the ascertainment of the degrees or *per centages* of the strength of spirits at the temperature of from thirty-five to seventy, both inclusive; I now proceed to shew by what variation of my hydrometer, the degrees of strength, greater or less than those above mentioned, may be ascertained. And this I accomplish in the following manner: that is to say; from forty *per cent* over proof, at the temperature of 55 or thereabouts, up to alcohol or pure spirit. I use a short stem instead of that above described, which I remove on this occasion, screwing on the latter in its stead, and which being lighter, the immersion of the instrument is diminished, and thereby adapted to the shorter stem; and on this short stem I mark the different gradations or *per centages* of strength, in like manner as I have herein-before mentioned in relation to the other stem, and which being duly attended to, no further description is necessary. In like manner I adapt the instrument to the ascertainment of the strength of spirits of a weaker quality than those first above mentioned, by putting on a longer stem instead of that first described, and by graduating such longer stem, so as to indicate the gradations or *per centages* of strength of the spirit to be examined: and in order to prevent evasion in the two last-mentioned cases, I think it proper to add, that though I have mentioned a shorter and longer stem, yet the same purposes may be answered by using in the one case a lighter, instead of a shorter stem, and in the other by using a heavier instead of a longer stem. In witness whereof, &c.

Specification

Specification of the Patent granted to Thomas Wilson, *of Bishop Wearmouth, in the County of Durham, Engineer; for uniting, combining, and connecting, the Metallic Patent Blocks of* Rowland Burdon *, *for the Construction of Arches.* Dated July 23, 1802.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that I the said Thomas Wilson, in compliance with the said proviso, do hereby describe and ascertain the nature of my said invention, and declare that my new-invented methods of uniting, combining, and connecting the metallic patent blocks of the said Rowland Burdon, for the construction of arches, are, first, instead of uniting the blocks by bar-iron on the outside of the arms and bolts fastened with cotterels or forelocks, as described in the specification of the said Rowland Burdon's invention, inrolled in his Majesty's high court of chancery, the 10th day of October, 1795, my method is to insert dowels or slots into the ends of the arms of blocks at the points of bearing, and to bring the blocks into close contact by driving wedges through the blocks and dowels, or slots, thereby combining the component parts of each rib in a more firm and substantial manner than has heretofore been practised, and considerably diminishing the draft or thrust of the arch. Secondly, instead of connecting and combining the ribs by means of hollow tubes, as described in the said Rowland Burdon's said specification, my method of connecting and combining the ribs is, by introducing between the blocks at the points of bearing, cross bars from rib to rib,

* For the specification of Mr. Burdon's patent see the fifth volume, page 361, of the first series of this work.

rib, with apertures therein of sufficient size to admit the dowels or slots which connect or combine the blocks together to pass through the same; by which means the ribs are kept in their required position, and the blocks do not bear against each other, but are kept in close contact with the cross bar, against which they abut, and are connected together by the dowels or slots, and wedges.

As a farther illustration of my second method, the following particulars, with the drawings in the margin, are descriptive of it, as applied to the construction of the iron bridge which I am now erecting over the river Thames at Staines.

Fig. 1, (Plate IV.) represents a dowel.

Fig. 2, two wedges of malleable iron.

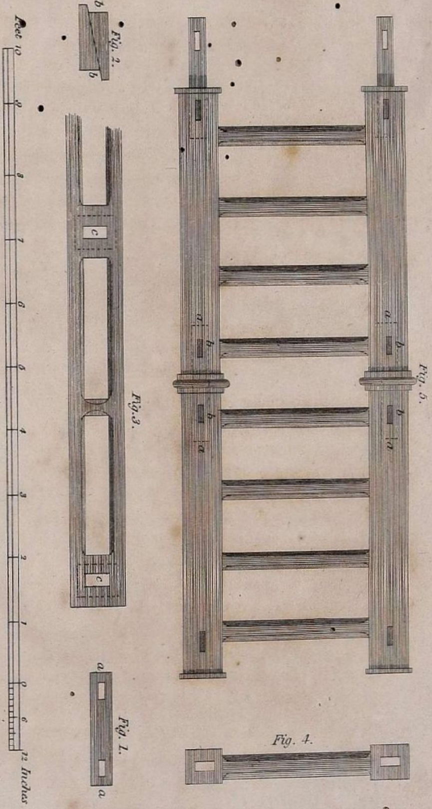
Fig. 3, part of a cross bar.

Fig. 4, end view of a block.

Fig. 5, two cast metal blocks, united together by the dowels *a*, *a*, *a*, *a*, and wedges *b*, *b*, *b*, *b*, which dowels pass through the aperture in the cross bars *c*, *c*.

The distance between the holes in the dowels being about a quarter of an inch less than that between the holes in the arms for receiving the wedges; by driving the wedges from each side of the blocks, the cross bars and blocks are brought into close contact. The arch of the bridge is a segment of a circle, whose chord or space is 180 feet, its versed sine or height 16 feet, and its breadth 27 feet. It consists of 6 ribs, and each rib is composed of 39 blocks.

In witness whereof, &c.


Feet 10 9 8 7 6 5 4 3 2 1 0 6 12 Inches
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.

Specification of the Patent granted to EDWARD STEPHENS, *of the City of Dublin; for a Furnace, Stove, or Fire-Place, that can conveniently be applied to the burning of Lime-Stone; at the same Time that it is used for the heating of all Manner of Corn Kilns, Evaporating Stoves, and Drying Houses for Malt, Corn, Flax, Cloth, Starch, or any other Material that requires drying or heating; that it is applicable to the making of Coke from Coal, smelting of Metals, heating of Boilers, and other such like Purposes.* Dated January 29, 1803.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Edward Stephens do hereby declare, that the following is a particular description of the said furnace, stove, or fire-place, and of its various forms as applied to its different purposes.

First, the drawing (Fig. 1, Plate V.) shews a section of a circular furnace completely fitted up, on a scale of one-eighth of an inch to a foot *: it is there applied to a corn or malt kiln of twenty feet square, where A represents a metal pan, or furnace with the frame it rests on, which frame also supports the sliding bars at bottom, for the purpose of letting out the lime intended to be burned therein; into this pan is put the coal, turf, culm, or coke, or other fuel intended to be used either separately or with lime-stone, iron ore, or any other material that may require to be burned, roasted, or smelted, and that can with safety be ignited under a kiln of said description, as by this means a double operation is performed, and the expense of fuel considerably saved; B represents a canopy

* The figures in the plate are reduced one third.

or cover of sheet iron which is placed over said pan, for the purpose of receiving the direct rays of the fire, and of increasing its power; C, the mouth-piece or furnace door, through which the fuel, stone, &c. is put into the pan; D is a brick arch, built at three inches distance from the sides and top of the canopy; this space of three inches is left open to admit a current of air into the body of the kiln, which air in its passage over the sheet iron gets much heated, and is thereby prepared to ascend in a strong current to the corn, malt, &c. that is spread above on the kiln floor, and well calculated to carry off its moisture with great rapidity, provided too much corn is not put on the kiln at once; the thickness recommended is about three inches of wheat, oats, or barley, and five inches of wet malt; E shews a section of the brick wall, that surrounds the metal pan as high as the upper flanch, but being also kept three inches distance, leaves a space or air chamber for letting into the kiln (by the small back aperture) another considerable portion of air that gets much heated in its passage round the pan, which is kept continually red-hot by the fuel and lime stone within; F is the spark plate, usually hung in open corn kilns for the purpose of spreading the heat more equally; but it is here used to break the current of hot air, which might otherwise entirely ascend through the centre of the kiln floor; G is the ash pit or space under the furnace where the lime falls, when the bars are drawn out for that purpose. Note, that this is to be done about every quarter of an hour, and fresh lime stone and fuel put in at the top of the pan, which ought to be constantly kept full, and as near the degree of uniform red heat as possible, as the better and stronger the fire is kept up, the greater quantity of heated air will pass into the kiln, and of course the greater effect will be produced.

Care

Care should be taken to draw but one or two sliding bars at a time, lest too much lime should descend at once, and thereby occasion the fire to decline; the holes at the sides and over the furnace door shew where the air is admitted, between the canopy and the brick arch that surrounds it; and the three holes under the door serve for a passage for air to get to the front of the heated pan, and also for sight holes to notice when it is sufficiently red; H is the main passage that leads to the furnace door, this is built with brick or stone, and arched or covered over; I, the metal sleeper that the furnace rests on, which is represented in the drawing as framed, but it may be formed of three separate pieces of metal, provided room is left for the sliding fire bars to draw in and out. The same letters refer to the separate parts of said furnace, which are drawn (in Figs. 2) on a larger scale of one quarter of an inch to a foot*. The remaining parts of the kiln as drawn in the annexed plan differ so little from those in general use, for drying malt or corn, that it is unnecessary to describe them more fully, particularly as the invention here claimed is only for the furnace and air chamber, their appendages and general application. It is, however, proper to say, that every aperture in the walls or roof of the kiln must be closed, that might admit cold air either under or over the corn, except the opening round the furnace. and that through the louvre or steam-passage in the roof. Note, such tiles as are best calculated to pass the greatest current of air through them are to be preferred: those in most general use are twelve inches square and two inches thick, and have holes or perforations so tapered as to prevent their being stopped by dust or grain.

This furnace, when used for a stove or drying house, acts on the same principle as last described: namely, by

* Reduced in the plate one-third.

conveying through the article to be dried a strong current of pure atmospheric air, heated to the degree required to produce the effect. The application of the furnace must however differ materially, when cloth, linen, cotton, hops, or any other description of goods are to be dried, which might receive injury from the dust arising from the fire below; therefore, in this case, it will be necessary to confine the fire flue very closely, and yet to take up almost the entire heat before it can make its way out of the said flue, which likewise acts as a chimney. In this case, K (Fig. 5 which is the elevation, and Fig. 6 the ground-plan) represents the furnace set in the same manner as when applied to the corn kiln, except that it here delivers its flame and heat into the brick fire flue L, which is eighteen inches square, and runs on the floor of the drying house, it has only a direct communication with the furnace at one end, and with the upright chimney at the other; across said fire flue are inserted the square sheet iron or copper pipes M, (Fig. 7,) of three inch bore and sufficient length to reach nearly through both walls of said flue, these pipes are placed diagonally as represented in the plan, and have their lower ends inserted in the air flue N, that is nine inches square and runs along the side of the fire flue, but are quite distinct from it. These two air flues have a communication with the air chamber formed round the metal pan, which is supplied with the external air through the lateral passages P; now when this fire is lit, the sheet iron pipes in the fire flues get heated to a high degree, and of course they draw in a supply of air from the air flue, which their lower end communicates. This air which comes warm from the air chamber gets farther heated in its passages through the heated pipes, delivers itself into the drying house, and is immediately followed by a fresh current, which when once produced will continue as long as the fire in the

the furnace is kept up; and after this air has seized the moisture of the article submitted to its action, they then pass off together through the louvre or steam pipes in the roof of the drying house.

It now remains for me to describe this fire-place as adapted to the heating, boiling, or evaporating any liquid, or to the heating of reverberating furnaces, ovens, &c. &c. in which case the direct flame may be first solely applied to their use, and having exerted its influence there, the remaining heat is afterwards taken up by the pipes placed diagonally in the fire flue or chimney as before described in the drying house, which chimney may either be upright or horizontal; for the more clearly understanding this application of the fire place, it is only necessary to refer to its situation in respect to the stove or drying house, where we find its full powers used to heat a number of pipes in a flue, from which can be easily understood that if a steam engine or other boiler, &c. a salt pan, or reverberating furnace or oven, was placed immediately over the fire place, or between it and the pipes W, that not only the desired effect would be produced, but the treble advantage obtained of burning lime, boiling water, &c. and heating a drying house of the greatest extent with a regular current of pure atmospheric air, raised to such a temperature as would best suit the article to be dried. Or should this furnace be required only to burn lime, and heat or boil any liquid, then it may be built of brick or any other material that stands the fire, and applied to the pan or boiler as represented in Fig. 8. In this situation I use one of them for heating a steam engine boiler, which it does effectually with about half the fuel used in my former fire place.

Lastly, my said invention consists not only in the construction of the furnace, but in the method of pro-

curing a strong current of heated air, and taking up nearly the entire result of the fuel before it can escape out of the chimney top, and also in the application of an air chamber which acts without a valve, register, or damper, and a fire place that requires but little or no expense to keep it constantly at work, being adapted to the effectual burning of lime and cheap fuel, which when burned can be occasionally drawn out, without stopping the process or injuring the ignited fuel remaining in the fire place, and that these furnaces or fire places can be made of various materials, and of different shapes and sizes according to the situation in which they are to be placed. The pipes in the fire-flue may be made of any material that readily transmits heat, and that they are applicable to all kind of kilns, drying houses, and boilers at present in use, as well as those that may hereafter be erected; when used in malt or corn kilns, a simple louvre or aperture at the top is sufficient to carry off the steam, therefore there is no necessity for a cow or moveable steam passage in the roof, as such an apparatus is no more required on a well constructed kiln than on a dwelling house chimney, that already freely permits the smoke to pass from the fire. This advantage, although considerable, is inferior to that of its preserving the health of the workmen, and the colour and quality of the grain which were generally much injured by the old kiln where air was imperfectly applied, and coal containing sulphur and other volatile substances too often used without any material being burned along with them that might correct their injurious tendency. Now this inconvenience will be hereafter done away, as it is well known that lime stone has the desired effect. This furnace adapted to a stove or drying house is so universally applicable, that there is scarcely a manufacture that may not receive considerable benefit by it, but particularly the

the woollen, linen, &c. &c. also the cotton printing trade; its use to the hop planters will appear evident, as hops are an article that require to be dried without injury to colour or flavour; it can also be easily applied to forcing or blow houses in gardens, and to the wards of hospitals where a regular supply of pure dry air is of so much consequence. Its use in saving fuel will be allowed on examining the top of the drying house chimney, even when coal is solely used, and comparing the small proportion of heat passing from it into the atmosphere, with the great proportion that goes from most chimneys in large manufactories; but when lime-stone can be procured the saving is still greater, as this article costs but a trifle at first, yet when burned is of considerable value, and in such universal use as to be absolutely necessary to many manufactories; but when lime stone cannot be had or burned to advantage, then turf, coal, wood, &c. may be effectually used, as these furnaces are adapted to the burning of all kind of fuel in general use, and by the means herein described, the principle objection to the erection of steam engines will be in a great measure removed, as the difficulty of procuring coal (particularly near large cities) has been the great obstacle in the way of this admirable piece of machinery getting into more general use. In witness whereof, &c.

References to Plate V.

Fig. 3, elevation of a malt or corn kiln. Fig. 4, ground plan; *a*, the coal-house; *b*, the lime-house. Fig. 5, *a*, *b*, lime and coal house; *c*, chimney. Fig. 7, cross section of fire and air flues, with their square pipes, say 2½ by 4 inches. Fig. 8, *a*, boiler; *b*, fire flues; *c*, chimney; *d*, damper; *e*, feeding-pipe; *f*, steam-pipe; *g*, lime-kiln; *h*, lime and coal house.

Specification

Specification of the Patent granted to Richard Pottinger, *of the Parish of Ealing, in the County of Middlesex, Engineer; for an Engine and Apparatus whereby Persons riding in Carriages may on Occasions, and in Circumstances of imminent Danger, liberate themselves, and escape impending Mischief, by freeing the Horse or Horses instantly from the Carriage; and, in Case of two Wheel Carriages, by causing them to stand in the same horizontal Position as they were before the Horse or Horses were freed from them by the Carriages stopping in the Space of a few Yards, without any violent Concussion, or Danger of overturning the Person in the Carriage, who may sit the whole Time with perfect Ease and Safety.* Dated February 27, 1802.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that I the said Richard Pottinger do hereby declare that my said invention is described in manner following; that is to say: For a curricle, the splinter-bar to be made of the best seasoned ash, with an hollow sunk in the back of it to receive an iron shaft or spindle, of about half an inch diameter, in two lengths, to which must be fixed four iron hooks, one at the end of each shaft, to move in a circular position; also an iron lever, with two flanchs, one of which is fixed to each shaft by nuts and screws. That part of the engine which falls to the ground, in order to assist in supporting and stopping the carriage, may appropriately be called anchor; which may be part wood and part iron, or wholly of iron, and is fixed to the axletree by two couplings screwed to it, at about eighteen inches asunder, or nine inches from the centre of the axletree, projecting about one

Fig. 3.

Fig. 1.

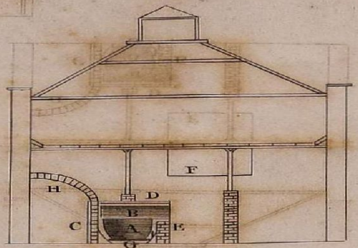


Fig. 4.

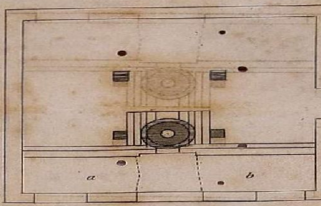


Fig. 8.

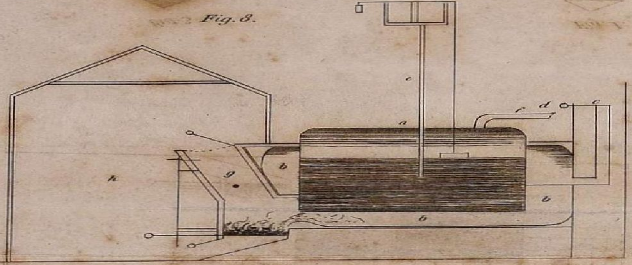


Fig. 2.

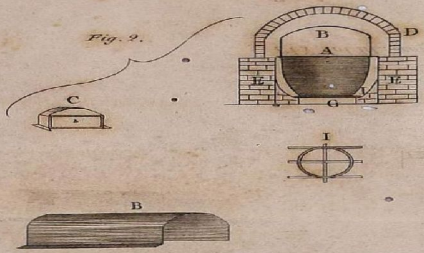


Fig. 5.

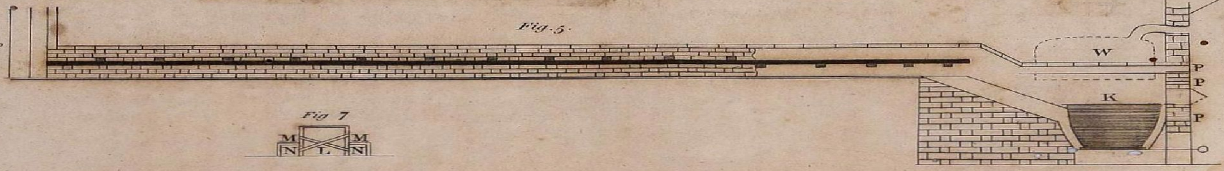
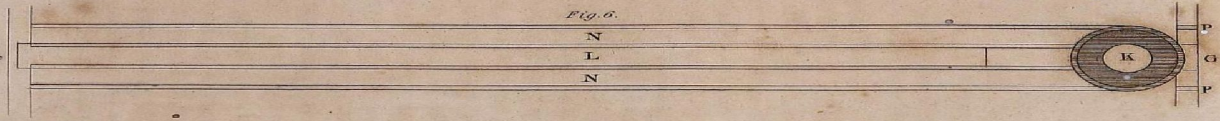


Fig 7

Fig. 6.



one inch from the axletree, with a small hole in it, sufficient to admit an iron pin, of about half an inch diameter; which pin passing through the two iron flanches attached to the anchor, as well as through the couplings, the anchor by that means moves from the centre of the small iron pin at the axletree, the lever resting on the anchor, as it may either be inclosed in a groove made to receive it on the upper side the said anchor, or the lever may be so constructed as to lay on each side of the anchor, and be supported by small bolts or rollers to rest on it. In either case, when the engine is raised up to as great a height as the carriage will admit of, it is fixed in that position by a spring bolt, from which there must be a small leather strap conveyed into the carriage. By a slight pull of the said strap, on the approach of danger, the anchor falls; and, together with the lever, stop and support the carriage. This movement of the lever turns the hooks, which are annexed to the iron shaft in the splinter-bar, and frees them from the shackles or rollers to which the traces are joined. The anchor may be provided with a roller, or two rollers, one of each side of it in the front end, that as it falls to the ground it will not stop the carriage too suddenly; or otherwise, if no roller is introduced, the front of the anchor which falls to the ground must be so formed as to prevent it stopping the carriage too suddenly. The horses being thus capable of being free from the carriage, excepting as to the connection with the pole, it becomes necessary that in the same instant they shall be free from the pole also; for which end there must be provided a leather or iron socket, to receive the end of the pole called the pole-piece, to which the straps must be fixed; and likewise a thin iron plate, to go from the said socket on the under side of the pole, to which the bar is fixed by other lea-

 ther-

ther-work, for supporting the carriage. At that end of the plate must be a mortise, to admit the trigger; which trigger is acted upon by means of a small iron rod passing from it in a groove on the under side of the pole, and connected with the lever; the movement of which either fixes the horses to the pole, or occasions their being liberated at the moment the traces are freed from the splinter-bar. The whole of the iron-work to the pole must be inclosed by leather-work, neatly executed, and in such a manner as not to obstruct the movements of any part of the same. For a one-horse chaise or gig the principle and apparatus will be the same as the curricle, with the exception of the iron shaft, which may work in boxes in front of the bar, or at the back of it, as described to the curricle. For four-wheel carriages, the apparatus must be the same as the curricle, except the fixing of the anchor, which, in order for preventing in cases of danger, and when the horses are freed from the carriage, must be fixed to the hind axletree or perch, by which means the moment it falls to the ground steadies the carriage, and prevents its turning out of the road. It likewise, by means of the two iron flukes attached to the anchor, will insure the carriage to stop in a few yards. The stem of the anchor, or sundry apparatus appertaining thereto, must be of sufficient length when fixed up so as to reach the end of the lever, that the same motions as before described to the curricle shall liberate the whole at the same moment. The small iron rod as described to lay in a groove on the under side of the pole of a curricle, must for a four-wheel carriage be continued of sufficient length for the trigger to work, and fix in a mortise in the pole-piece.

In witness whereof, &c.

A Cheap

A Cheap and Expeditious Method of Draining Land.

By T. B. Bayley, *Esq. F. R. S. and S. A.*

With a Plate.

From Hunter's Georgical Essays.

FROM a very extensive experience, I recommend the following method of draining land, as effectual, durable, and cheap.

First, make the main drains down the slope or fall of the field. When the land is very wet, or has not much fall, there should, in general, be two of these to a statute acre; for the shorter the narrow drains are, the less liable they will be to accidents.

The width of the trench for the main drains should be, at the top, about thirty inches; but the width at the bottom must be regulated by the nature and size of the materials intended to be used. If the drain is to be made of bricks ten inches long, three inches thick, and four inches in breadth, then the bottom of the drain must be twelve inches; but if the common sale bricks are used, then the bottom must be proportionably contracted. In both cases there must be an interstice of one inch between the bottom brick and the sides of the trench, and the vacuity must be filled up with straw, rushes, or loose mould. For the purpose of making these drains, I order my bricks to be moulded ten inches long, four broad, and three thick. These dimensions make the best drain; and I beg leave to be understood, throughout this essay, as speaking of bricks formed in the above manner.

The method I pursue in constructing my main drains is as follows:

When the ground is soft and spungy, the bottom of the drain is laid with bricks, placed across. On these, on each side, two bricks are laid flat, one upon the other, forming a drain six inches high and four broad. This is covered with bricks laid flat. (Fig. 2. Plate VI.)

When I first engaged in this mode of draining, I conceived that in places where the bottoms of the main drains were firm and solid, as of clay or marl, it would be an unnecessary expense to pave them with brick. Under this idea, I recommended them to be constructed as in Fig. 3, the sides being formed by placing one brick edgewise, instead of two laid flat. But after the experience of some years, I found that the access of air and the alternation of wet and dry, occasioned the hardest clay, or marl, to tumble down, whereby the side bricks, not having a paved bottom, were made to fall in. From the experience of this circumstance, I now direct the main drains to be invariably paved with brick, as represented in Fig. 2. This will render them as lasting as the sod, or pipe drains, which I have found free and open after being constructed twenty years. When stones are used instead of bricks, the bottom of the drain should be about eight inches in width. And here it will be proper to remark, that, in all cases, the bottom of the main drains must be sunk four inches below the level of the narrow ones, even at the point where the latter fall into them.

The main drains should be kept open till the narrow ones are begun from them, after which they may be finished: but before the earth is returned upon the stones, or bricks, it will be adviseable to throw in straw, rushes, or brush-wood, to increase the freedom of the drain.

The small narrow drains should be cut at the distance of sixteen or eighteen feet from each other, and should fall

fall into the main drain at very acute angles, to prevent any stoppage. At the point where they fall into, and eight or ten inches above it, they should be made firm withbrick or stone.

In making the narrow drains I employ four labourers. The first man, with a common spade, takes out the turf, or sods, eighteen inches wide (the drains being before marked out), and lays them carefully on one side; the second man, with a common spade also, digs out two, three, or more spits of earth (laying it on the other side of the trench) till he has cut through the soil, or staple, and come to the under-stratum of clay, marl, or other hard and solid body of earth. The bottom and sides of this trench must be cleanly wrought; and, allowing for the sloping of the sides in working, should, at the bottom, be clear sixteen inches wide.

In this trench the frame, Fig. 5. is laid; and, in the middle of it, the third man, who ought to be the strongest and most expert, works the long narrow draining spade in the body of the clay. By taking care to work it at its full depth, he is always sure of his level, if the drains are properly laid out. The wooden frame is of great use; it gives a firm support to the feet of the workman, keeps the bottom of the trench smooth and clean, and serves as a purchase to the wings of the narrow tool. Fig. 6, 7, 8, 9, 10.

When thirty or forty yards have been cut out by the draining spade, the fourth man cleans the bottom of the drain with the scoop, Fig. 11. and works it quite smooth; he then covers it with the sods, laying the grass side downwards. In this part of the work, too much care and attention cannot be used. The sods should be sound and dry, cut even on the sides, and fitted closely to each other. No broken or rotten pieces should be put in;

and

and if any of the sods taken out, in cutting the trench for the narrow drains, are bad, good ones, firm and full of roots of rushes, strong grass, &c. should be got in the other parts of the field, and their place supplied with the decayed ones. In marshy bad fields, where *sound* turf cannot be had, little sticks may be placed across the trench, and the loose and tender sods safely laid upon them. The narrow drains being thus covered, the earth must be thrown in again, taking care that the clay, &c. brought out by the narrow tool, be not mixed with it. No greater length of these drains should be cut than can be finished the same day. The price varies with the depth. For the main drains cut thirty inches above, and thirty-eight deep, laid with bricks, covered, &c. I give about ninepence *per* rod (eight yards). For the narrow drains, constructed and completely finished according to the foregoing directions, their whole depth (including that of the trench, and that of the draining spade) being thirty-two or thirty-four inches, I give fivepence half-penny *per* rod (eight yards *.)

From my much-respected friend, the Rev. Mr. Whately, of Nonsuch-Park, in Surry †, I first received an account of the Hertfordshire and Essex method of draining; at the same time he obligingly sent me a set of the tools made use of there, with very particular directions.

The great price of stone and brick in my neighbourhood rendered the Hertfordshire method too expensive. Hence I took the idea of the sod drains, and the improve-

* At this price my labourers, after they were a little acquainted with the work, earned, even in winter, two shillings a day each.

† Professor of Rhetoric in Gresham College.

ment

ment of the tools. Mr. Young, in the second edition of his justly-esteemed "Six Months' Northern Tour," calls me the inventor of this method of draining. All the merit I claim, is that of having introduced, together with an amendment of their construction, the application of these celebrated tools to a mode of draining with sods or turf, where stone, brick, or even brushwood, is extremely scarce and dear.

Wherever this is the case, I can, from my own experience, recommend the hollow drains covered in the above manner.

I must observe that, in loose crumbly soils, where the wetness does not arise from the retention of water by an under-stratum of clay, but from springs, these drains are *improper*; for such lands they should be made of brick or stone. On the contrary, which is most commonly the case, when the wet is prevented from passing off by an under-stratum of clay, marl, or a mixture of both, these sod drains are excellent.

For if the whole staple or soil is cut through as it ought to be, the narrow tool will be wholly worked in a solid body, and leave a firm compact ledge, or shoulder, of six inches wide on each side, for the sod to rest on, see Fig. 4. The strength with which the sods are supported, and their depth in the ground, will effectually prevent their removal by any weight on the surface, and secure them from all effects of the weather. Being, at their least depth, twelve inches below the surface, they will also be beyond the reach of the plough.

With respect to the shape of the narrow drains, it will be scarce necessary to observe, that their great depth, and contracted width, enable them to draw in the moisture of the earth, and at the same time to keep themselves clear and open.

The

The tools should be formed of well-wrought iron, and made with great care and exactness. Including the shaft, the narrow tool should weigh 12 lb. *

REFERENCES TO PLATE VI.

Fig. 1, a field with the drains properly laid out. A, A, A, the main drains; *a*, *a*, *a*, *a*, the narrow sod drains. Fig. 2, a brick drain; proper whether the bottom be hard or soft. Fig. 3, a brick drain; formerly recommonded when the bottom was hard, as of clay or marl; but discontinued for reasons already given. Fig. 4, a narrow drain; *a*, *a*, the shoulders for the sod to rest upon; *b*, the cut made by the narrow spade. Fig. 5, the wooden frame to be laid in the trench. It is made of two oak-boards, (inch thick) each twelve feet long, and six inches in breadth. They are fastened together at the ends by two ribs on the upper side, leaving a slit of five inches for the entrance of the narrow spade. *a*, the handle. Fig. 6, a front view of the narrow draining spade. *a*, the shaft; *b*, the wings for the workman's foot; *c*, the iron part of the spade, which is gently concave. Fig. 7, a side view. *a*, the shaft; *b*, the wings; *c*, two sharp fins, one on each side, for cutting the next spade-graft; *d*, the iron part. Fig. 8, a back view. *a*, the shaft; *b*, the wings; *c*, the cutting fins; *d*, the iron part which is convex. Fig. 9, a back view in perspective. *a*, the shaft; *b*, the wings; *c*, the fins; *d*, the iron part. Fig. 10, a front view in perspective. *a*, the shaft; *b*, the wings; *c*, the fins; *d*, the iron part. Fig. 11, the scoop. *a*, *a*, the wooden handle; *b*, the iron scoop.

* These tools are made by Benjamin Royle, smith, in Dolefield, Danesgate, Manchester; and by William Staveley, smith, in Stonegate, York.—Price 12s.

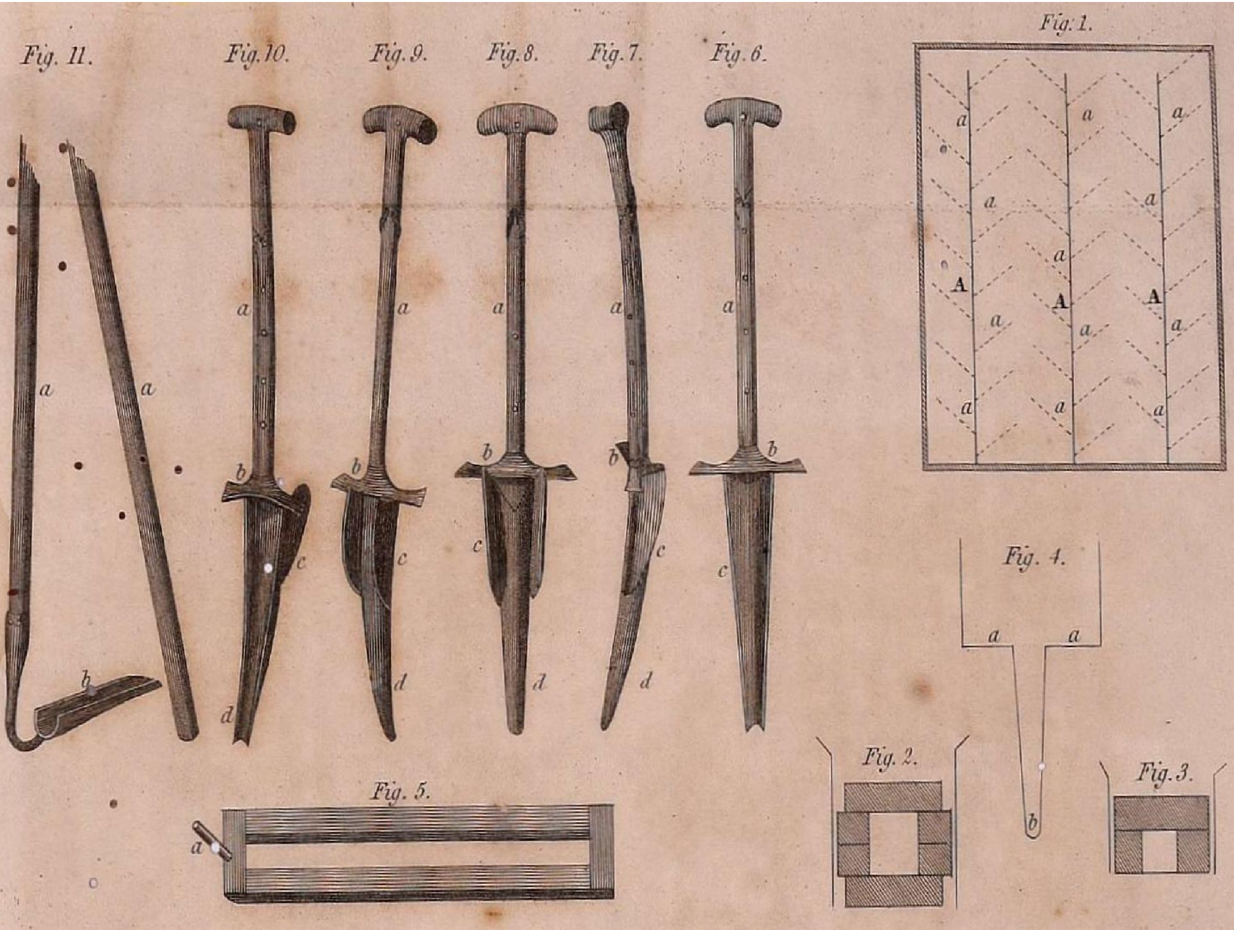


Fig. 11.
a
a
b
Fig. 10.
a
b
c
d
Fig. 9.
a
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c
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Fig. 8.
a
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Fig. 7.
a
b
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Fig. 6.
a
b
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Fig. 1.
a
A
Fig. 4.
a
b
Fig. 5.
a
Fig. 2.
Fig. 3.

Account of some Experiments and Observations on the constituent Parts of certain astringent Vegetables, and on their Operations in Tanning.

By HUMPHRY DAVY, *Esq.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

THE discovery made by M. Seguin, of a peculiar vegetable matter which is essential to the tanning of skin, and which is possessed of the property of precipitating gelatine from its solutions, has added considerably to our knowledge of the constituent parts of astringent vegetables.

M. Proust has investigated many of the properties of this substance; but, though his labours, and those of other chemists, have led to various interesting observations, yet they are far from having exhausted the subject. The affinities of tanning have been hitherto very little examined; and the manner in which its action upon animal matters is modified by combination with other substances, has been scarcely at all studied.

At the desire of the Managers of the Royal Institution, I began, in September, 1801, a series of experiments on the substances employed in the process of tanning, and on the chemical agencies concerned in it. These experiments have occupied, ever since, a considerable portion of my leisure hours; and I now presume to lay before the Royal Society an account of their general results. My chief design was, to attempt to elucidate the practical part of the art; but, in pursuing it, I was necessarily led to general chemical inquiries concerning the analysis of the different vegetable substances containing tannin, and their peculiar properties.

 I. *Ob-*

I. *Observations on the Analysis of astringent Vegetable Infusions.*

The substances that have been supposed to exist most generally in astringent infusions are, tannin, gallic acid, extractive matter.

The presence of tannin in an infusion, is denoted by the precipitate it forms with the solution of glue, or of isinglass. And, when this principle is wholly separated, if the remaining liquor gives a dark colour with the oxygenated salts of iron, and an immediate precipitate with the solutions of alum and of muriate of tin, it is believed to contain gallic acid, and extractive matter.

The experiments of Messrs. Fourcroy, Vauquelin, and Seguin, have shown that many astringent solutions undergo a change by exposure to the atmosphere; an insoluble matter being precipitated from them. A precipitation is likewise occasioned in them by the action of heat; and these circumstances render it extremely difficult to ascertain, with any degree of precision, the qualities of their constituent parts, as they exist in the primitive combination.

After trying several experiments on different methods of ascertaining the quantity of tannin in astringent infusions, I was induced to employ the common process of precipitation by gelatine, as being the most accurate.

This process, however, requires many precautions. The tanning principle in different vegetables, as will be seen hereafter, demands for its saturation different proportions of gelatine; and the quantity of the precipitate obtained by filtration is not always exactly proportional to the qualities of tannin and gelatine in solutions, but is influenced by the degree of their concentration. Thus, I found that 10 grains of dry isinglass, dissolved in two ounces of distilled

distilled water, gave, with solution of galls in excess, a precipitate weighing, when dry, 17 grains; whilst the same quantity, dissolved in six ounces of water, produced, all other circumstances being similar, not quite 15 grains. With more diluted solutions, the loss was still greater; and analogous effects took place, when equal portions of the same solution of isinglass were acted on by equal portions of the same infusion of galls diluted in different degrees with water; the least quantity of precipitate being always produced by the least concentrated liquor. In all cases, when the weak solutions were used, it was observed, that the residual fluid, though passed two or three times through the filtre, still remained more or less turbid and opaque; so that it is most likely that the deficiency arose from the continual suspension of some of the minutely divided solid matter in the liquid mass.

The solutions of gelatine, for the purposes of analysis, should be employed only when quite fresh, and in as high a state of saturation as is compatible with their perfect fluidity. I have observed, that in cases when they approach towards the state of jelly, their power of acting upon tannin is materially altered, and they produce, only a very slight precipitation. As the degree of fluidity of solutions of gelatine is influenced by their temperature, I have found it expedient in all comparative experiments to bring them, and the astringent infusions on which they are designed to act, as nearly as possible to a common degree of heat. My standard temperature has been between 60 and 70° Fahrenheit; and the solutions of gelatine that I have used were made by dissolving 120 grains isinglass in 20 ounces of water.

In ascertaining the proportions of tannin in astringent infusions, great care must be taken to prevent the presence of any excess of gelatine; for, when this excess exists, I

have found that a small portion of the solid compound formed is redissolved, and the results of the experiment otherwise affected. It is not difficult to discover the precise point of saturation, if the solution of isinglass be added only in small quantities at a time, and if portions of the clear liquor be passed through a filtre at different periods of the process. The properties of these portions will indicate the quantities of the solution of gelatine required for the completion of the experiment.

That the composition of any precipitate containing tannin and gelatine may be known with a tolerable degree of precision, it is necessary that the isinglass employed in the solution, and the new compound formed, be brought as nearly as possible to the same degree of dryness. For this purpose, I have generally exposed them, for an equal time, upon the lower plate of a sand-bath, which was seldom heated to more than 150°. This method I have found much better than that of drying at the temperatures of the atmosphere, as the different states of the air, with regard to moisture, materially influence the results.

Mr. Hatchett has noticed, in his excellent Paper on Zoophytes, &c.* that isinglass is almost wholly composed of gelatine. I have found, that 100 grains of good and dry isinglass contain rather more than 98 grains of matter soluble in water. So that, when the quantity of isinglass, in any solution employed for acting upon an astringent infusion, is compared with the quantity of the precipitate obtained, the difference between them will indicate the proportion of tannin, as it exists in the combination.

After the tannin has been separated from an astringent infusion, for the purpose of ascertaining its other component parts, I have been accustomed to evaporate the re-

* Phil. Trans. for 1800, page 327.

sidual

sidual liquor very slowly, at a temperature below 200° *. In this process, if it contains extractive matter, that substance is in part rendered insoluble, so as to fall to the bottom of the vessel. When the fluid is reduced to a thick consistence, I pour alcohol upon it. If any gallic acid or soluble extractive matter be present, they will be dissolved, after a little agitation, in the alcohol; whilst the mucilage, if any exist, will remain unaltered, and may be separated from the insoluble extract, by lixiviation with water.

I have made many experiments, with the hope of discovering a method by which the respective quantities of gallic acid and extractive matter, when they exist in solution in the alcohol, may be ascertained; but without obtaining success in the results. It is impossible to render the whole of any quantity of extractive matter insoluble by exposure to heat and air, without at the same time decomposing a portion of the gallic acid. That acid cannot be sublimed, without being in part destroyed; and, at the temperature of its sublimation, extractive matter is wholly converted into new products.

Ether dissolves gallic acid; but it has comparatively little action upon extractive matter. I have been able, in examining solutions of galls, to separate a portion of gallic acid by means of ether. But, when the extractive matter is in large quantities, this method does not succeed, as, in consequence of that affinity which is connected with

* M. Deyeux has shewn, (*Annales de Chimie*, Tome XVII. page 86,) that in the process of evaporating solutions of galls, no gallic acid is carried over by the water, at a temperature below that of ebullition. Many astringent infusions, however, lose a portion of their aromatic principle, even in cases when they are not made to boil; but this substance, through evident to the smell, in the water that comes over, cannot be detected by chemical reagents.

mass,

mass*, the greatest part of the acid continues to adhere to the extract.

Alumine has a strong attraction for extractive matter; but comparatively a weak one for gallic acid †. When carbonate of alumine is boiled for some time with a solution containing extractive matter, the extractive matter is wholly taken up by the earth, with which it forms an insoluble compound; but into this compound some of the gallic acid appears likewise to enter; and the portion remaining dissolved in the solution is always combined with alumine.

I have not, in any instance, been able to separate gallic acid and extractive matter perfectly from each other; but I have generally endeavoured to form some judgment concerning their relative proportions, by means of the action of the salts of alumine, and the oxygenated salts of iron. Muriate of alumine precipitates much of the extractive matter from solutions, without acting materially upon gallic acid; and, after this precipitation, some idea may be formed concerning the quantity of the gallic acid, by the colour it gives with the oxygenated sulphate of iron. In this process, however, great care must be taken not to add the solution of the sulphate of iron in excess; for, in this case, the black precipitate formed with the gallic acid will be redissolved, and a clear olive-coloured fluid only will be obtained.

The saline matters in astringent infusions adhere so strongly to the vegetable principles, that it is impossible to ascertain their nature with any degree of accuracy by means of common reagents. By incineration of the pro-

* See Bertholiet, *Recherches sur les Lois de l'Affinité. Mém. de l'Institut National.* Tome III. p. 5.

† See Fiedler, *Journal de Chimie, par* J. B. Van Mons, Tome I. pag. 85.

ducts

ducts obtained from the evaporation of astringent infusions, I have usually procured carbonate of lime and carbonate of potash.

In the different analyses, as will be seen from the results given in the following sections, I have attended chiefly to the proportions of the tanning principle, and of the principles precipitable by the salts of iron, as being most connected with practical applications.

With regard to the knowledge of the nature of the different substances, as they exist in the primitive astringent infusion, we can gain, by our artificial methods of examination, only very imperfect approximations. In acting upon them by reagents, we probably, in many cases, alter their nature; and very few of them only can be obtained in an uncombined state. The comparison, however, of the products of different experiments with each other, is always connected with some useful conclusions; and the accumulation of facts with regard to the subject must finally tend to elucidate this obscure but most interesting part of chemistry.

II. *Experiments on the Infusions of Galls.*

I have been very much assisted in my inquiries concerning the properties of the infusions of galls, by the able Memoir of M. Deyeux, on galls *.

The strongest infusion of galls that I could obtain, at 56° Fahrenheit, by repeatedly pouring distilled water upon the best Aleppo galls broken into small pieces, and suffering it to remain in contact with them till the saturation was complete, was of the specific gravity 1.068. Four hundred grains of it produced, by evaporation at a temperature below 200°, fifty-three grains of solid matter; which, as well as I could estimate, by the methods of

* *Annales de Chimie*, Tome XVII. pag. 1.

analysis

analysis that have been just described, consisted of about $\frac{9}{10}$ of tannin, or matter precipitable by gelatine, and $\frac{1}{10}$ of gallic acid, united to a minute portion of extractive matter.

100 grains of the solid matter obtained from the infusion left, after incineration, nearly $4\frac{1}{4}$ grains of ashes; which were chiefly calcareous matter, mixed with a small portion of fixed alkali. The infusion strongly reddened paper tinged with litmus. It was semitransparent, and of a yellowish-brown colour. Its taste was highly astringent.

When sulphuric acid was poured into the infusion, a dense whitish precipitate was produced; and this effect was constant, whatever quantity of the acid was used. The residual liquor, when passed through the filtre, was found of a shade of colour deeper than before. It precipitated gelatine, and gave a dark colour with the oxygenated sulphate of iron.

The solid matter remaining on the filtre, slightly reddened vegetable blues; and, when dissolved in warm water, copiously precipitated the solutions of isinglass. M. Proust †, who first paid attention to its properties, supposes that it is a compound of the acid with tannin: but I suspect that it also contains gallic acid, and probably a small portion of extractive matter. This last substance, as is well known, is thrown down from its solutions by sulphuric acid; and I found, in distilling the precipitate from galls of sulphuric acid, at a heat above 212°, that a fluid came over, of a light yellow colour, which was rendered black by oxygenated sulphate of iron; but which was not altered by gelatine.

* The fact of the precipitation of solution of galls by acids, was noticed by M. Dize. See *Annales de Chimie*, Tome XXXV. p. 37.

Muriatic

Muriatic acid produced, in the infusion, effects analogous to those produced by sulphuric acid; and two compounds of the acid and the vegetable substances were formed: the one united to excess of acid, which remained in solution; the other containing a considerable quantity of tannin, which was precipitated in the solid form.

When concentrated nitric acid was made to act upon the infusion, it was rendered turbid; but the solid matter formed was immediately dissolved with effervescence, and the liquor then became clear, and of an orange colour. On examining it, it was found that both the tannin and the gallic acid were destroyed; for it gave no precipitate, either with gelatine or the salts of iron, even after the residual nitric acid was saturated by an alkali. By evaporation of a portion of the fluid, a soft substance was obtained of a yellowish-brown colour, and of a slightly sourish taste. It was soluble in water, and precipitated nitro-muriate of tin, and the nitrate of alumine; so that its properties approached to those of extractive matter; and it probably contained oxalic acid, as it rendered turbid a solution of muriate of lime.

When a very weak solution of nitric acid was mixed with the infusion, a permanent precipitate was formed; and the residual liquor, examined by the solution of gelatine, was found to contain tannin.

A solution of pure potash was poured into a portion of the infusion. At first, a faint turbid appearance was perceived; but, by agitation, the fluid became clear, and its colour changed from yellow brown to brown red; and this last tint was most vivid on the surface, where the solution was exposed to the atmosphere. The solution of isinglas did not act upon the infusion modified by the alkali, till an acid was added in excess, when a copious precipitation was occasioned.

 The

The compound of potash, and solution of galls, when evaporated, appeared in the form of an olive-coloured mass, which had a faint alkaline taste, and which slowly deliquesced when exposed to the air.

Soda acted upon the infusion in the same manner as potash; and a fluid was formed, of a red-brown colour, which gave no precipitate to gelatine.

Solution of ammonia produced the same colour as potash and soda, and formed so perfect an union with the tannin of the infusion, that it was not acted upon by gelatine. When the compound liquor was exposed to the heat of boiling water, a part of the ammonia flew off, and another part reacted upon the infusion, so as to effect a material change in its properties. A considerable quantity of insoluble matter was formed; and the remaining liquor contained little tannin and gallic acid, but a considerable portion of a substance that precipitated muriate of tin, and the salts of alumine.

When the experiment on the ebullition of the compound of the infusion and ammonia was made in close vessels, the liquor that came over was strongly impregnated with ammonia; its colour was light yellow, and, when saturated with an acid, it was very little altered by the salts of iron. The residual fluid, after the process had been continued for some time, as in the other case, precipitated gelatine slightly, but the salts of alumine copiously; and it gave a tinge of red to litmus paper.

When solutions of lime, of strontia, or of barytes, were poured in excess into a portion of the infusion, a copious olive-coloured precipitate was formed, and the solution became almost clear, and of a reddish tint. In this case, the tannin, the gallic acid, and the extractive matter, seemed to be almost wholly carried down in the precipitates; as the residual fluids, when saturated by an acid, gave no

precipitate

precipitate to gelatine, and only a very slight tint of purple to oxygenated sulphate of iron.

When, the solutions of the alkaline earths were used only in small quantities, the infusion being in excess, a smaller quantity of precipitate was formed, and the residual liquor was of an olive-green colour; the tint being darkest in the experiment with the barytes, and lightest in that with the lime. This fluid, when examined, was found to hold in solution a compound of gallic acid and alkaline earth. It became turbid when acted on by a little sulphuric acid; and, after being filtrated, gave a black colour with the solutions of iron, but was not acted upon by gelatine.

When a large proportion of lime was heated for some time with the infusion, it combined with all its constituent principles, and gave, by washing, a fluid which had the taste of lime-water, and which held in solution only a very small quantity of vegetable matter. Its colour was pale yellow; and, when saturated with muriatic acid, it did not precipitate gelatine, and gave only a slight purple tinge to the solutions of the salts of iron. The lime, in combination with the solid matter of the infusion, was of a fawn colour. It became green at its surface, where it was exposed to the air; and, when washed with large quantities of water, it continued to give, even to the last portions, a pale yellow tinge.

Magnesia was boiled in one portion of the infusion for a few hours; and mixed in excess with another portion, which was suffered to remain cold. In both cases, a deep green fluid was obtained, which precipitated the salts of iron, but not the solutions of gelatine; and the magnesia had acquired a grayish-green tint. Water poured upon it became green, and acquired the properties of the fluid at first obtained. After long washing, the colour of the

magnesia changed to dirty yellow, and the last portions of water made to act upon it were pale yellow, and altered very little the solutions of iron.

When the magnesia was dissolved in muriatic acid, a brownish and turbid fluid was obtained, which precipitated gelatine and the oxygenated salts of iron. So that there is every reason to believe, that the earth, in acting on the astringent infusion, had formed two combinations; one containing chiefly gallic acid, which was easily soluble in water; the other containing chiefly tannin, which was very difficultly soluble.

Alumine boiled with the infusion became yellowish-gray, and gave a clear white fluid, which produced only a tinge of light purple in the solutions of iron. When the earth * was employed in very small quantity, however, it formed an insoluble compound only with the tannin and the extract; and the residual liquor was found to contain a gallate of alumine with excess of acid.

The oxides of tin and of zinc, obtained by nitric acid, were boiled with separate portions of the infusion for two hours. In both cases, a clear fluid, which appeared to be pure water, was obtained; and the oxides gained a tint of dull yellow. A part of each of them was dissolved in muriatic acid. The solution obtained was yellow: it copiously precipitated gelatine; and gave a dense black with the salts of iron. M. Proust †, who first observed the action of oxide of tin upon astringent infusions, supposes that portions of tannin and gallic acid are decomposed in the process, or converted, by the oxygen of the oxide, into new substances. These experiments do not, however, appear to confirm the supposition.

* Mr. Fiedler, I believe, first observed the action of alumine upon tannin. Van Mons' Journal, Vol. I. page 86.

† *Annales de Chimie*, Tome XLII. p. 69.

M. Deyeux

M. Deyeux observed, that a copious precipitation was occasioned in infusion of galls, by solutions of the alkalis combined with carbonic acid. M. Proust has supposed that the solid matter formed is pure tannin, separated from its solution by the stronger affinity of the alkali for water; and he recommends the process, as a method of obtaining tannin.

In examining the precipitate obtained by carbonate of potash fully combined with carbonic acid, and used to saturation, I have not been able to recognise in it the properties which are usually ascribed to tannin; it is not possessed of the astringent taste; and it is but slightly soluble in cold water, or in alcohol. Its solution acts very little upon gelatine, till it is saturated with an acid; and it is not possessed of the property of tanning skin.

In various cases, in which the greatest care was taken to use no excess, either of the astringent infusion or of the alkaline solution, I have found the solid matter obtained possessed of analogous properties; and it has always given, by incineration, a considerable portion of carbonate of potash, and a small quantity of carbonate of lime.

The fluid remaining after the separation of the precipitate was of a dark-brown colour, and became green at the surface, when it was exposed to the air. It gave no precipitate to solution of gelatine; and afforded only an olive-coloured precipitate with the salts of iron.

When muriatic acid was poured into the clear fluid, a violent effervescence was produced; the fluid became turbid; a precipitate was deposited; and the residual liqour acted upon gelatine and the salts of iron, in a manner similar to the primitive infusion.

M. Deyeux, in distilling the precipitate from infusion of galls by carbonate of potash, obtained crystals of gallic acid. In following his process, I had similar results; and a fluid

a fluid came over, which reddened litmus-paper, and precipitated the salts of iron black, but did not act upon gelatine.

When the precipitate by carbonate of potash was acted upon by warm water, applied in large quantities, a considerable portion of it was dissolved; but a part remained, which could not in any way be made to enter into solution; and its properties were very different from those of entire precipitate. It was not at all affected by alcohol: it was acted on by muriatic acid, and partially dissolved; and the solution precipitated gelantine and the salts of iron. It afforded, by incineration, a considerable portion of lime, but no alkali.

In comparing these facts, it would seem, that the precipitate from infusion of galls consists partly of tannin and gallic acid united to a small quantity of alkali, and partly of these vegetable matters combined with calcareous earth; and it will appear probable, when the facts hereafter detailed are examined, that both the potash and the lime are contained in these compounds in a state of union with carbonic acid.

The solutions of carbonate of soda and of carbonate of ammonia, both precipated the infusion of galls in a manmer similar to the carbonate of potash; and each of the precipitates, when acted on by boiling water, left a small quantity of insoluble matter, which seemed to consist chiefly of tannin and carbonate of lime.

The entire precipitate by carbonate of soda produced, when incinerated, carbonate of soda and carbonate of lime. The precipitate by carbonate of ammonia, when exposed to a heat sufficient to boil water, in a retort having a receiver attached to it, gave out carbonate of ammonia, (which was condensed in small crystals in the neck of the retort,) and a yellowish fluid, which had the

strong

strong smell and taste of this volatile salt. After the process of distillation, the solid matter remaining was found of a dark brown colour; a part of it readily dissolved in cold water, and the solution acted on gelatine.

The residual fluid of the portions of the infusion which had been acted on by the carbonates of soda and of ammonia, as in the instance of the carbonate of potash, gave no precipitate with gelatine, till they were saturated with an acid; so that, in all these cases, the changes are strictly analogous.

The infusion of galls, as appears from the analysis, contains in its primitive state calcareous matter. By the action of the mild alkalis, this substance is precipitated in union with a portion of the vegetable matter, in the form of an insoluble compound. The alkalis themselves, at the same time, enter into actual combination with the remaining tannin and gallic acid; and a part of the compound formed is precipitated, whilst another part remains in solution.

When the artificial carbonates of lime, magnesia, and barytes, were separately boiled with portions of the infusion of galls for some hours, they combined with the tannin contained in it, so as to form with it insoluble compounds; and, in each case, a deep green fluid was obtained, which gave no precipitate to gelatine, even when an acid was added, but which produced a deep black colour in the solutions of the salts of iron.

Sulphate of lime, when finely divided, whether natural or artificial, after having been long heated with a small quantity of the infusion, was found to have combined with the tannin of it, and to have gained a faint tinge of light brown. The liquid became of a blue-green colour, and acted upon the salts of iron, but not upon gelatine; and there is every reason to suppose, that it held in solution a triple compound of gallic acid, sulphuric acid, and lime.

We

We owe to M. Proust the discovery that different solutions of the neutral salts precipitate the infusion of galls; and he supposes, that the precipitation is owing to their combining with a portion of the water which held the vegetable matter in solution. In examining the solid matters thrown down from the infusion, by sulphate of alumine, nitrate of potash, acetite of potash, muriate of soda, and muriate of barytes, I found them soluble, to a certain extent, in water, and possessed of the power of acting upon gelatine. From the products given by their incineration, and by their distillation, I am however inclined to believe that they contain, besides tannin, a portion of gallic acid and extractive matter, and a quantity of the salt employed in the primitive solution.

It is well known, that many of the metallic solutions occasion dense precipitates in the infusion of galls; and it has been generally supposed that these precipitates are composed of tannin and extractive matter, or of those two substances and gallic acid, united to the metallic oxide; but, from the observation of different processes of this kind, in which the salts of iron and of tin were employed, I am inclined to believe, that they contain also a portion of the acid of the saline compound.

When the muriate of tin was made to act upon a portion of the infusion, till no more precipitation could be produced in it, the fluid that passed through the filtre still acted upon gelatine, and seemed to contain no excess of acid; for it gave a precipitate to carbonate of potash, without producing effervescence. The solid compound, when decomposed by sulphureted hydrogen, after the manner recommended by M. Proust, was found strongly to redden litmus-paper, and it copiously precipitated nitrate of silver; whereas, the primitive infusion only rendered it slightly turbid; so that there is every reason to believe, that the pricipitate contained muriatic acid.

By

By passing the black and turbid fluid, procured by the action of solution of oxygenated sulphate of iron in excess upon a portion of the infusion, through finely-divided pure flint, contained in four folds of filtrating paper, I obtained a light olive-green fluid, in which there was no excess of sulphuric acid, and which I am inclined to suppose was a solution of the compound of gallic acid and sulphate of iron, with superabundance of metallic salt. I have already mentioned that gallic acid, when in very small proportion, does not precipitate the oxygenated salts of iron; and M. Proust, in his ingenious Paper upon the Difference of the Salts of Iron, has supposed that, in the formation of ink, a portion of the oxide of iron in union with gallic acid is dissolved by the sulphuric acid of the sulphate. This comes near to the opinion that they form a triple compound: and, in reasoning upon the general phenomena, it seems fair to conclude, that, in the case of the precipitation of tannin by the salts of tin and of iron, compounds are formed, of tannin and the salts; and that, of these compounds such as contain tin are slightly soluble in water, whilst those that contain iron are almost wholly insoluble.

In examining the action of animal substances upon the infusion of galls, with the view of ascertaining the composition of the compounds of gelatine, and of skin, with tannin, I found that a saturated solution of gelatine, which contained the soluble matter of 50 grains of dry isinglass, produced from the infusion a precipitate that weighed nearly 91 grains; and, in another instance, a solution containing 30 grains of isinglass, gave about 56 grains; so that, taking the mean of the two experiments, and allowing for the small quantity of insoluble matter in isinglass, we may conclude, that 100 grains of the compound of gelatine and tannin, formed by precipitation from saturated solutions,

solutions, contain about 54 grains of gelatine, and 46 of tannin.

A piece of dry calf-skin, perfectly free from extraneous matter, that weighed 180 grains, after being prepared for tanning by long immersion in water, was tanned in a portion of the infusion, being exposed to it for three weeks. When dry, the leather weighed 295 grains; so that, considering this experiment as accurate, leather quickly tanned by means of an infusion of galls consists of about 61 grains of skin, and 39 of vegetable matter, in 100 grains.

After depriving a portion of the infusion of all its tanning matter, by repeatedly exposing it to the action of pieces of skin, I found that it gave a much slighter colour to oxygenated sulphate of iron, than an equal portion of a similar infusion which had been immediately precipitated by solution of isinglass; but I am inclined to attribute this effect, not to any absorption of gallic acid by the skin, but rather to the decomposition of it by the long continued action of the atmosphere; for much insoluble matter had been precipitated, during the process of tanning, and the residuum contained a small portion of acetous acid.

In ascertaining the quantity of tannin in galls, I found that 500 grains of good Aleppo galls gave, by lixiviation with pure water till their soluble parts were taken up, and subsequent slow evaporation, 185 grains of solid matter. And this matter, examined by analysis, appeared to consist,

Of tannin	130 grains.
Of mucilage, and matter rendered insoluble by evaporation	12
Of gallic acid, with a little extractive matter	31
Remainder, calcareous earth and saline matter	12

The

The fluid obtained by the last lixiviation of galls, as M. Deyeux observed, is pale green; and I am inclined to believe, that it is chiefly a weak solution of gallate of lime. The ashes of galls, deprived of soluble matter, furnish a very considerable quantity of calcareous earth. And the property which M. Deyeux discovered in the liquor of the last lixiviations, of becoming red by the action of acids, and of regaining the green colour by means of alkalis, I have observed, more or less, in all the soluble compounds containing gallic acid and the alkaline earth.

TO BE CONCLUDED IN OUR NEXT.

On the Preparation of the Bulbs of the Hyacinthus non Scriptus, or common Blue-Bell, as a Substitute for Gum Arabic.

By Mr. THOMAS WILLIS, *of Lime-street, London.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was voted to Mr. Willis *for this Communication.*

IN the year 1794, whilst collecting plants in a wood for botanical specimens, I observed that the root of the Hyacinthus non scriptus, the plant commonly called Blue-Bells, or Hare-Bells, was extremely mucilaginous; and on tasting it, I discovered only a very slight pungency. I collected a pound of the Bulbs, and, after slicing and drying them before a fire, they yielded about four ounces of powder. I thought that by keeping the powder some

 time;

time, the little acridness might go off, as it does in the arum-root powder. I tasted it about six months after, and found it perfectly insipid. I concluded it might be rendered useful for food or nourishment, but at that time pursued the matter no farther.

In the spring of 1800, gum-arabic having been a long time very dear, and likely to continue so, I thought this mucilaginous root might answer some of its purposes, for external use. I therefore procured seven pounds and a half of the Bulbs, which, when sliced and dried, produced two pounds of powder. Being soon afterwards in company with Mr. Charles Taylor, Secretary to the Society of Arts, &c. I mentioned to him that I had discovered a root which grew in great plenty in this kingdom, yielded a very strong mucilage, and which I imagined would answer the purposes of gum-arabic, in some of the manufactories. He said, if I pleased, he would send some of it down to Manchester, to be tried by the calico-printers.

Three or four ounces of the powder were given him, and sent down there: he was informed, upon trial, that it answered the purposes of fixing the calico-printers colours, equally as well as gum-arabic; and in the same proportion, of an ounce and a half of the powder, to four ounces of the mordant. Mr. Taylor received the samples of the printed cottons on which it had been used.

On the 15th of January, 1801, I furnished Mr. Taylor with eight ounces more of the powder; but have not since heard the result.

As this root can be easily procured, and used at a less price than gum-arabic has been sold for several years past, I think it may be rendered of great utility; and the Society

ciety of Arts, &c. by patronizing it, may be the means of making it a public benefit.

Care should be taken, and advice given, that the woods should not be left destitute of the roots; and it would be adviseable to offer premiums for cultivating the roots and offsets, as they are very increasing. By such means a constant supply may be had, if the roots answer the intended purposes.

I do not presume to offer any thing respecting the mode in which the Society may think proper to divulge the discovery, and promote the use of these roots; but I imagine, that if the roots are bruised and used fresh, they would answer the purpose better than when dried and powdered; and as it is now a proper time of the year for taking them up, and will continue to be so for two months, I wish that the discovery may be made known as soon as possible.

I have sent you specimens both of the dried roots and powder, that they may be seen at the Society's rooms, by the calico-printers. What I have done have been scorched a little in drying; but the colour would be much better, if proper care was taken in drying them.

From the trials made before the Committee with this Powder, with hot and cold water, from samples of the printed cotton produced which had been printed with it instead of Gum Senegal, and from experiments made in Manchester, it appears that the Hyacinthus non scriptus may, in many cases, be found a useful substitute for Gum-Arabic.

Extract

Extract from the Report on the Discovery of bituminous Wood; read to the Ligurian National Institute. By M. Mojon, *Public Professor of Chemistry, and Member of the Institute.*

From the Annales de Chimie.

In a plain about half a league from the mouth of the Magra, in the district of Castel Nuovo, on the confines of the Italian Republic, a vast quantity of bituminous wood has lately been discovered. It is situated in a soil formed of argillaceous and calcareous strata of greater or less depth, and very irregular through their whole extent. The nature of the fossil as well as the disposition of the soil, unquestionably prove that these strata must have been formed by some great convulsion which destroyed and overwhelmed whole forests.

This bituminous wood which in some places is scarcely covered by the soil still preserves its original form. In the researches that have been made trunks of different thickness, up to six decimetres, have been extracted; the transverse section of some is of an elliptic form, as if produced by pressure.

The colour of the fossil is in some instances a perfect black, in others a greyish black, and in others again, a wood-like brown. The black is sometimes extremely shining, having even the brilliancy of glass; the other two kinds are naturally dull, but are capable of being very highly polished.

Its texture is completely that of wood, having undergone no alteration from the bitumen which has penetrated it, so that it may frequently be decided to what trees such or such pieces have belonged.

This

This wood is not so brittle as coal, and if sawed perpendicularly to the axis of the trunks it presents a solid, compact, and very smooth surface. It takes fire readily, without the aid of other combustibles, and gives a bright clear flame whilst burning. The heat it produces is more powerful and steady than that of any other vegetable charcoal, and when once lighted it never goes out till entirely consumed, and leaves but a small quantity of ashes. The combustion may be interrupted and resumed at pleasure.

It weighs less than coal, its specific gravity being to that of distilled water as 1235 to 1000: those pieces which have the appearance of oak are even lighter.

In this fossil is sometimes found sulphureted iron distributed in larger and smaller particles, which, when long exposed to the air, are decomposed, and destroy the pieces on which they happen to be.

In other respects it possesses all the properties of coal; but if naturalists have long been in doubt respecting the origin of coal, on account of the variety of its texture, the irregularity of its form, its fragility, its strata resembling schistous stones, &c. the fossil of Castel Nuovo throws no difficulties in the way of their researches. The uniformity of the texture, the invariable direction of its fibres, the bark of the different trunks, the knots, the colour of the various species, the facility with which it takes fire, the alkali contained in its ashes; all these strongly-marked characters render it perfectly similar to artificial charcoal of wood. It should likewise be added, that it possesses this singular property, that it is capable of being employed for turnery work with the greatest facility, and that it thereby acquires a polish and brightness which render it far superior to ebony. It is, finally, a conductor of the electric fluid, and readily transmits it.

After

After this brief account of the locality and nature of the fossil, it may not be improper to mention some of the experiments made by the author to ascertain the purposes for which this substance might be advantageously employed.

He burned four hectogrammes of this bituminous wood in a fire-place, fixing a thermometer at the distance of two decimetres at a temperature of 10 degrees (Reaumur); in 16 minutes the wood was completely on fire; it gave a bright clear flame, less smoke than coal, and a slight smell of bitumen, which was not sulphureous, nor did it in the least incommode those who were nearest to it. The thermometer rose to 42 degrees, and eight hectogrammes of water that were set over the fire in a copper vessel began to boil. The thermometer remained at the same point twelve minutes, and the water continued boiling twenty minutes. When the ebullition had ceased, the thermometer fell to 26 degrees, and the water was reduced to one hectogramme. The fossil was entirely consumed in an hour and a quarter, leaving 15 grammes, of a reddish yellow, impalpable powder in the form of flakes.

He afterwards repeated the experiment, under the same circumstances, with oak-charcoal. The latter was ignited in twelve minutes, and in four more the eight hectogrammes of water in the copper vessel began to boil; the thermometer rose to 38 degrees, where it remained for eighteen minutes, and when the ebullition ceased it fell to 25. Almost all the water was evaporated, and the charcoal, which was consumed in the space of an hour and a half, left only one decagramme of ashes.

By this experiment, calculating the sum total of the heat respectively produced by the two substances during combustion, the author remarked that the bituminous wood

wood produced 816 degrees of heat on the thermometer in an hour and a quarter, whilst oak-charcoal raised only 784 in an hour and a half.

He likewise tried whether this fossil might be employed with advantage in the forge for iron. He made the two extremities of an iron rod red-hot for some time, one in bituminous wood, and the other in an equal quantity of oak-charcoal. When he took the rod from the fire he found the two extremities equally ductile, malleable, and tenacious. In all probability this new combustible might even be employed in reducing iron ore, but this the author had not an opportunity of ascertaining.

M. Mojon's report concludes with the following analysis:

This fossil wood yields almost the same product as coal, excepting the ashes, which contain a small quantity of potash.

By distillation are obtained phlegm, a yellowish bituminous oil, a quantity of carbonic acid gas, carbureted hydrogen gas, and at last an empyreumatic oil, much thicker than the former.

In alkohol a portion of this wood, after some time, yielded a blackish resinous substance.

By ebullition in distilled water calcareous earth and argile are precipitated.

If nitric acid be poured on this fossil, it is decomposed, and nitric gas is disengaged from it.

Finally, the 15 grammes of ashes, obtained by the above-mentioned combustion of 4 hectogrammes of this fossil, gave by lixiviation and filtration 5 decigrammes of potash, oxyd of iron, alumine, lime, and magnesia.

Essay on the Fecula of Green Plants.

(Concluded from Page 73.)

PARMENTIER was the first I believe who doubted that the tincture of feculæ in alkohol was resinous, because it was not precipitated by water. Yet, if we consider that water cannot separate it from gluten, that alkohol, oils, and greasy matters only possess that property; finally, that this substance when separated by alkohol and concentrated, is a fat tenacious body, insoluble in water, we must acknowledge, that there is no vegetable product which it resembles so nearly as resin; but we are about to shew that to render this character more decisive it is only necessary to add a little oxygen.

Oxygenated muriatic acid in a few days bleaches and hardens green resin, which then becomes ropy, like turpentine, and its tincture is diffusible in water; so that if the green portion of the feculæ belonged to those coloured juices which exist in the ingredients composing the tincture, the addition of oxygen would not convert it into a resin. But now that observation has taught us not to establish such rigorous limits as formerly to vegetable products, since we so frequently see them connected by intermediate qualities, we are not much surprised to see that a resin, elevated to the maximum of its divisibility, is capable of combining with water. Do not we see camphor, essential and vegetable oils, &c. completely dissolve in water? Yet we should not think of excluding similar products from the classification which their analysis has assigned them.

In oxygenated muriatic acid, green feculæ assume the colour of withered leaves, the winter livery of vegetable nature, and their tincture renders water extremely turbid.

bid. It is therefore but reasonable to conclude, that though the colouring part of feculæ is incapable of resisting water when transmitted to it by alkohol, yet all its other qualities proclaim it an, absolutely resinous substance; and notwithstanding this product, one of the most curious of the vegetable kingdom, which it embellishes by the variety of its tints, has been omitted, in the *system of chemical knowledge*, yet Rouelle, Daniel, Sage, Parmentier, and other chemists, have thought it worthy of investigation.

This resin dissolved in potash, leaves it to attach itself to silk, and tinges it a bright green, but too fading to be of utility; it is however capable of resisting verjuice, but its attraction for gluten in preference to vegetable fibre is conformable to established principles; for, in general, colouring bodies attach themselves to animalised substances rather than to the fibres of flax, hemp, and cotton. There must therefore be in fecula a substance analogous to wool, silk, &c.; and this is gluten.

V. Let us now examine the fecula by tests more capable of developing new characters of animalisation.

If fecula that has been boiled, or in a crude state, be immersed in water in summer, it begins to smell disagreeably in twenty-four hours; it soon exhales a stench like that of excrement, to which probably a person could not long expose himself without danger. The infectious miasma which issues from it instantly discolours metallic writings, and its liquor resembling purulent matter as quickly tarnishes silver.

To the corruption of this principle rather than to any other cause, are doubtless owing the pernicious exhalations from hemp and flax whilst steeping. Running water, equally proper for steeping them with standing water, quickly carrying off their extractive juices, nothing

capable of being destroyed by steeping can remain, excepting the fecula which connects the green fibres.

The liquor in which putrefied fecula has been immersed for a year contains sulphureted hydrogen, carbonate of ammonia, and gluten dissolved by means of the latter.

This liquor has the peculiar property of preserving its stercoral smell after long ebullition. The produce of it when distilled contains carbonate of ammonia combined with an infectious principle, which does not blacken metallic solutions, and with the nature of which I am utterly unacquainted. Acids do not weaken it by precipitating the fecula and saturating the ammonia, which induces me to think that if the effluvia of a mass of putrefied animal matter are capable of serving as a vehicle to the phosphorus and sulphur which it contains, that it is not those combustible matters alone which produce the infection. How very different, for instance, is the smell of putrefied fish or flesh, corrupted fecula or rotten cheese, from that of phosphureted and sulphureted hydrogen.

On Putrefaction.

But what is putrefaction? An alteration respecting which we have very few distinct ideas.

When fecula, curd, flesh, organised matters in general, have arrived at a certain period of this alteration, commonly called Putrefaction, they suddenly stop at a permanent state, where combinations unknown to us await them, as if to preserve, to embalm them, so as to insure their duration in this new state, and to protect them from all subsequent destruction.

When, for example, curd, fecula, gluten, or flesh, after having passed through the stages of putridity, and those alterations of colour and form by which they are disfigured, and have at length arrived the one at the cheesy state, the

the vegetable matters at that of mould, earth, powder, to which flesh however is not reduced after fifteen years of ichorous stagnation, they all stop at that point, without ever attaining, at least under our eyes, that final dissolution, which must terminate their existence, or reduce them to a mere earthy, inert matter, *non absimile cineribus*, to use the expression of Stahl, in short to a state in which no trace can any longer be perceived of the principles by which they were organised.

A putrefaction so complete never takes place. But we no sooner perceive an alteration in the organisation of a vegetable or animal matter, lividness, putridity, than we instantly imagine that it is beginning; and without being aware of it, we confound those appearances and those phenomena belonging to a kind of fermentation with which we are but little acquainted, and without reflecting whether its end accords with the ideas we have of it, whether it be actually the operation decreed by nature to analyse and resolve into the last elements those substances which are subjected to it.

Let us, therefore, conclude, that absolute putrefaction is a thing of which we are utterly ignorant. But to return to fecula, it is time to examine that kind which is sufficiently fine to pass through the filtre.

VII. Let us take, for instance, the filtered juice of the cabbage, one of those plants which yield it in the greatest quantity. And the better to observe, at the same time, the difference between this second fecula and albumen, we shall submit the latter to the same experiments. The white of an egg beat up in a pint of water will furnish the liquor necessary for the comparison.

1. Into water, heated to 50 degrees, plunge two matrasses, one with filtered juice and the other with albumen. The juice in an instant becomes turbid with cheesy

cheesy flakes which fall to the bottom. The albumen at the same temperature experiences not the least alteration.

2. On a furnace place two matrasses, one with juice diluted with 20 parts of water and the other with albumen. But the fecula, be it ever so much diluted, is completely separated from it by heat. This clearly proves its insolubility. On the other hand the water of albumen as it grows hot appears turbid, without ceasing to be transparent; it may be boiled and concentrated, and yet it deposits no flakes nor any substance like fecula. If evaporated in an open vessel, it leaves nothing but a varnish of white of egg. Darcet has already demonstrated that albumen diluted with a great proportion of water, cannot be again separated from it by heat. Albumen is a soluble mucilage, fecula is not, and the temperature which coagulates the former, makes no alteration in the state of the latter.

3. The water of albumen keeps several days without alteration; the juice of plants, on the contrary, is continually changing, which interrupts its transparency. If you filtre a juice, it becomes muddy; repeat the process, it still grows muddy; and, after all, it continually deposits white fecula.

4. Albumen turns the juice of violets green, and alters reddened turnsol to blue.

White fecula washed produces none of those alterations. And how should it? The juices of cabbages, hemlock, and many others, redden turnsol. But albumen has not the property of imparting a green colour by itself; for that purpose, it is well known that a mixture of alkali is requisite.

5. Alkohol separates from the water of albumen light, transparent, glary flakes, which appear on the filtre like boiled white of egg. The juice of plants with alkohol yields

yields only a whitish opaque powder, which soon settles to the bottom of the vessel.

6. All acids, hydro-sulphureted water, and ammonia, precipitate fecula dissolved in juices; but these re-agents make no alteration in water of albumen.

Oxygenated muriatic acid precipitates and oxydates white fecula; the same acid at first oxydates and then precipitates albumen.

7. Crystallized carbonate of pot-ash, of magnesia, marine salt, muriate of pot-ash, sal-ammonia, salt-petre, &c. thrown into a filtered juice, precipitate the fecula as they are dissolved. The water of albumen is not rendered turbid by any of those salts.

Consequences.

The white fecula deposited spontaneously or by alkohol, acids, salts, &c. is insoluble in water. It is the contrary with albumen; the acids which precipitate fecula, make no alteration in the solution of albumen.

No salt is capable of separating the albumen from water; but fecula combines so imperfectly with water, that any of them can effect a separation by precipitating it.

White of egg dried and again softened is restored to the volume, opacity, and colour of boiled albumen: white feculæ on the contrary become extremely brown. Most of them even turn quite black in drying, as those of cresses, cabbage, *solanum licopersicum*, &c. and if they grow soft in water, yet they never assume the same appearances in it as are known to belong to white of egg. In short, this fecula is nothing but part of the gluten which constitutes the basis of green feculæ. For example, if we compare the fecula of white cabbage, separated by filtration, to that which its juice yields by heat, when both are cleared from their colouring parts, there is not the smallest difference

ence between them. But it is the white fecula that dissolves the most easily, because it is not, like the green, in a state of combination which prevents it. All plants contain a portion of gluten which, having never been called into action by the light, remains colourless.

Cabbages, endive, cellery, and plants blanched by art, likewise furnish white fecula, but in far less quantity than if they remained green. The stalk of the cabbage and of hemlock give a pale fecula compared with that of their leaves. But in general, it is not necessary that vegetables should be externally high-colored to prove that they are rich in gluten. Houseleek yields an abundant, highly-coloured fecula, and particularly rich in wax as will presently be shewn.

VIII. But albumen (it may be urged) being the only product observed to possess the property of coagulating by heat, it appears to be a natural conclusion that, &c. But milk of almonds likewise coagulates by heat, alkohol, acids, &c. It is a fact that has always been known in pharmacy, and yet from this circumstance it has never been concluded that emulsions contain white of egg, because even if characters of animalisation were perceived in the principle of the emulsion, they would require to be combined with other striking marks of resemblance, in order to be considered albuminous *.

* The comparison made by Rouelle of the green juice of plants to an emulsion, was much better founded than he imagined. The cheese separated from milk of almonds by one of the above methods washed and dried, affords oil by expression, and afterwards all the products of caseum by distillation. This is doubtless the reafon why almonds and all kernels give so great a quantity of azote with nitric acid.

Milk of almonds contains gum, a small quantity of extractive matter and sugar, which is either of the nature of cane-sugar, or of that which I have discovered in grapes, and which I shall describe in treating of fermentation.

It

It is in the same point of view that the gluten of feculæ must be considered; since it is neither tenacious nor elastic, nor susceptible of fermentation like that of wheat *. Rouelle, in announcing it to chemists as a product analogous to that of wheat, intended to present but a part of the characters which connect them, those only that belong to the nature of the component parts, since there are no external marks of resemblance; therefore, my object in defending the labors of this great master, is rather to retain in this catalogue of his discoveries, that of an animalised matter more particularly found in leaves, than gluten properly so called, because it is this discovery which the author of the *System* has rendered doubtful in his work. Destroy the aggregation of animalised matters, take away their forms from silk, horn, wool, feathers, &c. it is clear that, considered only with regard to their constituent parts, they will form albumen, gluten, fibre, &c. and even if these constituent parts are in all respects the same, which has not yet been examined, although by that method alone they can be distinguished from each other, yet the proportions should be determined in which nature has combined them to give them existence.

But, it may be rejoined, if albumen be not obtained from juices, with characters as distinct as you desire, it must necessarily be ascribed to the extractive matter, salts, and acids that always accompany it, and which must disguise it a little; it is particularly in the mixture of flower and water that it should be sought, to be found of a purity that leaves no doubt of its nature. Let us examine then what this mixture will afford us.

* The gluten of wheat is susceptible of a fermentation peculiar to itself. The gases which are disengaged from it are carbonic acid and hydrogen, very pure and in great abundance.

IX. Flower-water is like juice recently filtered in a state of progressive alteration, and which ceases only when the acid produced by the fermentation of the saccharine principle has precipitated the gluten.

All the acids and salts that we have applied to juices operate in the same manner on the flower-water and alkohol likewise; but not vinegar, because it dissolves the gluten. In short, it is not by coagulation that acids separate the gluten from juices and from flower-water, since ammonia and salts do the same, but rather by seizing upon the solvent of the substance which appears to derive its solubility solely from its fineness, and not from any affinity similar to that which unites gums, sugar, and albumen to water.

Flower-water exposed to a heat of 50 degrees parts with its gluten like the juice of plants. Dilution with a very great quantity of water is equally incapable of imparting solubility to gluten. Upon the application of the smallest degree of heat, it falls of itself.

I collected an ounce of gluten separated by heat from the liquor. I kept it in its humid state; it fermented, and produced vinegar and ammonia. It is now, after a space of two years, a dark cellular mass, with the same smell and taste as the cheese of gluten.

Let us then conclude that albumen has not yet been discovered in vegetables; nevertheless it must not be inferred that it cannot be formed in them as well as in animals. The age in which we live, more fertile in discoveries than any of the preceding, daily demonstrates that there are few products in either kingdom that can be considered as absolutely peculiar to it. Yet it must be admitted that to establish the existence of albumen by the exclusion of gluten from green plants, the learned author of the *System* has relied too much on the feeble

support

support of mere appearances. Before he published his ideas on albumen he ought, I think, to have confirmed his first opinion by more conclusive facts than merely that of concrescibility. But we must not forget that in so vast an enterprise as his, it is extremely difficult for an author to form all the materials of his structure with equal precision.

On this account I shall extend these conclusions to other products which Fourcroy has placed, without sufficient examination, among the glutinous substances of vegetables.

There exist, he says, more accurate and positive observations than Rouelle's, on the presence of this glutinous matter in the vegetable texture which forms linen, paper, &c. page 296, vol. VII. To call this passage to the author's recollection will be sufficient; were I to enter more into particulars, it would have too much the air of censure. Fourcroy will, I think, omit it in a new edition, as well as that on the paste of mallows. If the latter has a right to a place among the animalised products of vegetables, we must likewise class among them the paste of almonds, and those of frangipane, eggs, marmalade, &c.

With respect to bird-lime, of which he speaks in the same chapter, every one knows that it is only a kind of turpentine, an inflammable aromatic resin, soluble in alkohol, formed by vegetation in the filamentary texture of the holy-oak, in the berries and perhaps in the bark of the elder, &c. but that it is by no means a glutinous substance.

X. Pot-ash easily dissolves green fecula and divides it into two parts; one of these attaches itself to the solvent, and the other is separated in the form of a green powder, on which even fresh pot-ash produces no effect. This powder, when washed and dried, gives by distillation the

 pro-

products of white wood and linen, but nothing of the nature of ammonia. This is the woody part which trituration introduces into the fecula.

This solution has all the characters of an animal solution; it exhales ammonia and the same kind of smell as wood; it tarnishes silver, and when acted upon by acids, emits effluvia which blacken writing with white metals.

But in this instance, as in the soap of wool, great part of the fecula is consumed which changes the arrangement and proportion of its radicals. Acids separate from it a very small quantity of fecula. The remainder assumes the character of extract which disposes it to combine with water.

Neither alkohol nor acids can separate this new extract from salts. It is fawn-coloured; and muriate of tin forms in it a dark lake-coloured precipitate. The other (the fecula) when collected, washed, and filtered, is still found to possess the extraordinary property of hardening in boiling water.

Alkohol produces with precipitated fecula a much more solid green than with fresh. The cause of this is, that the resin which cannot be destroyed like gluten, combines, in much greater quantity, with that part which has escaped destruction. By distillation, this fecula yields ammoniacal products.

XI. An acid of 18 or 20 degrees abundantly disengages azote from green fecula; a stronger acid easily dissolves it, and separates from it a small quantity of powder, which is the woody residue of the plant.

However sparingly nitric acid is used, crystallized oxalic acid is rarely obtained. It resolves itself into water and carbonic acid.

The solutions of feculæ always contain bitter yellow of welter, sulphuric acid, benzoic acid, calcareous oxalate,

and

and tallow. If a solution of fecula charged with iron, that of the solanum lycopersicon for example, be precipitated with acetite of lead, a powder composed of oxalate, phosphate of lead and oxyd of iron, is obtained. By means of the blow-pipe the lead itself is consumed and dissipated, and only a globule of phosphate of iron remains.

When a vegetable product contains azote, sulphur, phosphorus, benzoic acid, tallow, a bitter yellow, and iron in abundance; we may be assured that it belongs to the class of animalised substances.

Of Wax.

XII. Wax is the work of vegetation, and not of bees. I imagine it is by feeding upon the gluten with which it is accompanied in the powder of the stamina that they separate it. This powder yields abundance of ammonia, which induces me to think that it contains gluten; and since I have discovered wax in certain feculæ, I presume that, if this dust were to be treated with nitric acid, wax would be found in consequence.

The fecula of common house-leek furnished it in a quantity that surprized me. This wax is white, dry, brittle, without smell, it cannot be confounded with those sebaceous products obtained from other feculæ, as those of hemlock and solanum. Messrs. Fernandez and Chabaneau examined it to convince themselves of that circumstance, chewed it, and agreed that this product was a perfect wax.

The fecula of green cabbage likewise gave some, but in much less quantity. Wax appears to me to be a varnish, with which vegetation covers plants, without doubt to preserve them from the effects of any moisture that might be prejudicial to them. It is this varnish that divides the rain and dew into silvery pearls on the leaves of cabbages, poppies, and many other vegetables, and gives

gives such additional beauty to our gardens. It is likewise the wax which the curious gardener, in presenting a plumb, a fig, or a grape, cautiously avoids rubbing off with his fingers.

When an orange is taken, at Paris, from the paper in which it has been wrapped from its leaving Portugal, it is found covered with a farinaceous substance that may be taken off with the blade of a knife, when its nature may be ascertained by holding it to the candle and melting it.

The fecula of opium, likewise, contains a tallow which nearly resembles wax in the firmness of its consistence, and which has been discovered by many naturalists.

Finally, raw silk is also covered with wax, which is carried off together with the colour by alkohol, and is separated from the latter by cooling.

Of several kinds of Fecula less known.

XIII. When 5 or 6 pounds of saffron are treated for the sake of the volatile oil and extract, in the decoction is perceived a fine powder which renders it turbid, is deposited, and may be separated by filtration. This powder, when washed, assumes in drying the horny quality of green feculæ in summer; it quickly putrefies, and breeds worms if not taken care of. This fecula yields, by means of fire, all the products of gluten. With alkalis and lemon-juice, it stains silk a very brilliant yellow.

Borage.

A plant may contain gluten in two states, in the fecula, and dissolved in its juice by means of pot-ash. Such is the juice of borage. When clarified, it is thick, and of a light blue colour, a few drops of acid separate from it a cheesy curd, which may be collected on the filtre, and which is nothing but gluten.

Elder.

Elder.

Its berries, together with a highly coloured, very gummy, and somewhat saccharine juice, contain a fecula as green as that of spinach, when completely cleared of the red colour. Alkohol extracts from it a green tincture; the remainder is a gluten differing in no respect from that of fecula.

In crushing these berries, their gluten attaches itself to the fingers; it has the same consistence as that of the holy-oak: their juice, when left to ferment, gives a small quantity of spirit of a disagreeable smell. It is followed by an astonishing quantity of excellent distilled vinegar.

Buck-thorn.

Its juice which contains a bitter, nauseous, extract, gum, and a small quantity of sugar, is thickened with a greenish slime, of which it is deprived by heat and fermentation. This pulp, when well-washed, is of a bright green, and consists of gluten mixed with a small quantity of fibre. It yields carbonate of ammonia, &c.

The Rose.

Its petals, triturated, yield a fine light coloured fecula, which affords the same products as gluten.

Grapes.

They contain an abundant fecula, which forms the lees of wine; but if I were to treat of this product, I should anticipate what I shall have to say on fermentation. In short, gluten exists in quinces, apples, and, doubtless, in other fruit; it is contained in acorns, Spanish chesnuts, horse-chesnuts, rice, barley, rye, pease, and beans of all kinds. I shall return to this subject in treating of the difference between sprouted wheat and that which has not undergone this operation.

Memoir

Memoir on the various Alterations produced in Muriates of Mercury by the Action of different Bodies.

By M. Boullay, *Apothecary of Paris.*

From the Annales de Chimie.

Having frequently had occasion to remark that superoxygenated muriate of mercury undergoes a more or less considerable alteration in the different liquids with which it is mixed for the purposes of medicine, I thought it would be useful to the physician to ascertain the degree of alteration, and at the same time serviceable to chemistry, to discover the precise manner in which different bodies act upon that salt. For this purpose I undertook a series of experiments, and I shall give the details of those more particularly interesting to chemists and physicians. The former will find in them many facts which do not agree with those already published. The latter will see that it is not indifferent whether this or that medicinal substance, or excipient, be mixed with the corrosive sublimate. They will discover the causes of the inefficacy, and frequently dangerous consequences, of this medicine, in the hands of quacks.

Preparation of the Corrosive Sublimate employed in the various Experiments.

I introduced oxygenated muriatic gas into a bottle three-fourths full of distilled water, in which I had, previously, diluted oxydated mercury. When the solution was complete, I evaporated the liquor, which being brought to a proper degree of concentration, furnished, when cold, very beautiful, pointed crystals, of superoxygenated muriate of mercury.

N. B.

N. B. I employed this process, in order to procure the salt at the highest degree of purity. The purest sold in the shops always contains about a hundredth part of mild mercury, which may easily be separated, as it cannot be dissolved.

Action of Light.

Experiment I. Ten grammes of this salt, in crystals, were put into a glass phial, and exposed to the sun's rays, at a temperature varying from 30 to 40 degrees of the centigrade thermometer. They soon became efflorescent, and, in a month's time, were of a dirty grey colour; they had lost their regularity of form, and had produced small crystallizations, which had attached themselves to the edges, and even the outside of the phial. In this state they were diluted with warm, distilled water, which dissolved them, leaving a greyish pulverulent residuum, weighing, when dried, two grammes: it was insoluble in water, either warm or cold, in alkohol, and acetous acid: it turned a piece of gold white when rubbed upon it.

The solution still contained some of the salt in the state in which it had been employed.

Experiment II. I put a like quantity of the crystals, of the same salt, into a phial, and placed it in a cupboard, from which the light was excluded. They only became efflorescent, and when dissolved in water left scarcely any residue.

Experiment III. Ten grammes of the same muriate were dissolved in ten parts of boiling distilled water: this solution being put into a bottle, which it filled almost entirely, crystallized as it became cold. A small tube was affixed to it, communicating underneath with a bell full of water. The bottle was exposed to the sun

 for

for the same time as in the first experiment. On the first day part of the crystals was re-dissolved, in consequence of the heat; the others separated, and gaseous bubbles displaced part of the water in the bell. The crystals which had resisted the dissolving power of the sun's heat lost their transparency, and were covered with bubbles, which rose, with the slowest motion, to the surface of the liquid. Viewed through a magnifying glass at the time when it was heated by the sun, the liquor appeared like a collection of extremely diminutive bubbles. I several times examined the gaseous fluid introduced underneath the bell; it always exhibited the characters of atmospheric air.

Wishing to bring the experiment to a conclusion, I unluted and introduced the elastic fluid contained in the upper part of the bottle, under a bell: I plunged into it a lighted taper, the flame of which burned considerably stronger; but not so strong as in pure oxygen gas. I poured tincture of turnsol into the solution which was very perceptibly reddened by it.

The saline part was dissolved in hot distilled water, and left, as a residue, only a gramme of a pulverulent deposit; similar, in every respect, to that of Experiment I.

Experiment IV. For the sake of comparison I placed a like quantity, prepared in the same manner, in a dark place. There was no disengagement of gas; a few crystals were separated, without losing any thing of their excessive whiteness, and were completely dissolved at the conclusion of the experiment by the aid of heat.

These experiments prove, decisively, the action of light on super-oxygenated muriate of mercury; the results of which are the extraction of a small quantity of oxygen and acid, and the formation of mild mercury.

Action

Action of Charcoal.

Experiment I. I took two parts of charcoal, separated from the carbonate of soda by phosphorus, and mixed with one part of oxygenated muriate of mercury, both in powder. To these I added a sufficient quantity of distilled water to form, altogether, an almost solid mass; which was left for a month in a dark, cool, place. This paste was then boiled, alternately, in distilled water, alkohol, and acetous acid. The corrosive sublimate was completely dissolved in the water; the two other agents produced no effect upon it. The residue dried, and, heated in a retort, yielded globules of mercury, and vapours of muriatic acid.

Experiment II. Pieces of light and well-burned charcoal, were plunged into a solution of corrosive sublimate, and left, in that state, an equal length of time with the former experiment. This charcoal, taken out of the liquid and dried, appeared covered with a white efflorescence; it was washed in distilled water, which detached, but without dissolving, part of the efflorescence. This white, pulverulent matter, settled at the bottom of the water, and was mild mercury.

The liquor which had been employed for the experiment still contained a great quantity of corrosive sublimate.

Experiment III. A mixture of two parts of pure charcoal with one part of corrosive sublimate, in powder, was introduced into a fluted glass retort, provided with a recipient, communicating with a bottle filled with pure water. The retort was gradually heated, at a reverberating furnace, till it began to melt. The produce was a very small quantity of corrosive sublimate and of mild mercury, in the upper part of the body of the retort. The neck

contained grey oxyd of mercury and globules of that metal. In the ball which served as a recipient were deposited liquid mercury and muriatic acid. The water in the bottle was likewise slightly impregnated with that acid.

This first trial encouraged a hope that I should effect the total decomposition of the salt by charcoal, and that it would afford a method of accurately analyzing that salt by the separation of its constituent principles. I therefore tried the following experiments.

Experiment IV. I took 10 grammes, or 100 decigrammes, of oxygenated muriate of mercury, and twice that weight of pure charcoal. I incorporated them in a porcelain mortar, with a sufficient quantity of distilled water to form a solid mass, which I introduced in small portions into a porcelain retort. I heated it very gradually till I had extracted all the water employed for incorporating the two powders. This water when examined was extremely pure, forming no precipitate either with lime-water or sulphureted hydrogen, and left no residue by gentle evaporation. I then changed the recipient; to that adapted to the mouth of the retort, I joined a bottle with three necks, two-thirds full of a solution of crystals of nitrate of silver, and which I made to communicate with another bottle, containing a very considerable quantity of lime-water. From the latter bottle a tube conducted to the hydro-pneumatic apparatus.

The apparatus being thus arranged, I applied a gradual and long continued heat to promote the reciprocal action of the oxygen on the charcoal and the muriatic acid on the caloric. When the operation was concluded, I found in the neck of the retort, and in the first recipient, 76 decigrammes of liquid mercury and two decigrammes of grey oxyd of the same metal; in the first bottle

bottle a deposit of muriate of silver, which, when dried, weighed 72 decigrammes. This quantity, according to Bergman, produces 18 decigrammes of muriatic acid. In the bottle of lime-water was a carbonated deposit which, when dried, weighed 10 decigrammes.

The carbonic acid of this calcareous carbonate did not contain all the oxygen disengaged from the corrosive sublimate, part of which had passed in its gaseous state underneath the bell: the whole quantity amounted to three or four decigrammes.

According to these results, 100 parts of corrosive sublimate would be composed of

Mercury	78
Muriatic acid	18
Oxygen	from 3 to 4

I state these proportions not so much as an accurate analysis of this salt, as because they prove the complete reduction of muriates of mercury by charcoal, although they likewise clearly demonstrate that the corrosive sublimate contains a much greater quantity of metal, and less muriatic acid, than Bergman asserted.

This decomposition of corrosive sublimate by charcoal appears to have been hitherto thought impossible, since M. Fourcroy, in his *System of Chemical Knowledge*, under the article *Corrosive Sublimate*, has the following expression: "*Carbon does not act upon this salt, either cold or hot.*"

Action of Phosphorus.

Into a small glass retort I introduced 10 grammes of super-oxygenated muriate of mercury dissolved in a sufficient quantity of distilled water, and added five grammes of phosphorus, which was covered to the depth of two inches

inches by the liquid. The retort being placed on a sand-bath, with a suitable apparatus, was heated till half of the liquid had passed into the recipient. I then unluted and examined the produce, which was pure water; what remained in the retort was poured into a glass for experiments. It was composed of a blackish, phosphorescent, and very combustible matter, shining like carburet of iron: by friction, white smoke of phosphoric acid was disengaged from it, and very small globules of metallic mercury were observed interspersed among it. This matter, weighing about 10 grammes, was considered to be phosphuret of mercury, with excess of metal, like what Pelletier had obtained by the action of phosphorus on red oxyd of mercury.

The super-natant liquor, this phosphuret, was very clear, and had somewhat of the smell of phosphorus whilst burning, and a very strong acid, but not the least metallic taste. With lime-water it precipitated white and very light flakes, which instantly dissolved again, excepting a great quantity of this re-agent was added. It contained no mercurial salt, and nitrate of silver demonstrated the presence of muriatic acid in abundance.

On the subject of the action of phosphorus on corrosive sublimate, M. Fourcroy only says that this salt is decomposed by phosphorus, but less speedily than by nitrate of mercury, the latter salt having less affinity with its basis; but as he is silent respecting the results of that experiment, of which I have no where seen a description, I thought I ought not to omit the statement of that which I made, and of the method it affords of procuring phosphuret of mercury.

Action of Acids.

Nitric acid, with the assistance of heat, dissolves corrosive sublimate and precipitates it as it cools without alteration, in the form of irregular crystals. Bergman announced this solution of nitric acid, but Fourcroy speaks of a disengagement of oxygenated muriatic acid, which I could not perceive in this experiment, though I repeated it several times.

Action of the same Acid on mild Muriate of Mercury.

Experiment I. Into a small retort I put one ounce or 32 grammes of mild mercury, two ounces or 64 grammes of pure nitric acid, at 36 degrees, and half an ounce (16 grammes) of distilled water. To this retort, placed in a reverberating furnace, I adjusted a globular recipient, corresponding with the pneumatic apparatus by means of a tube with several curves. I heated the nitric acid till it boiled: in the first moment of ebullition the retort, and afterwards the rest of the apparatus, were filled with red vapours of nitrous acid gas; at the same time a perfectly white liquid passed into the recipient; no air but what had been expanded in the vessels was conducted under the bell. As soon as the solution of the muriate was complete, I stopped the operation. The retort, when cold, contained a clear liquid, covered with a saline pellicle, which being broken by shaking, was precipitated on a considerable quantity of irregular crystals that had been formed. These crystals were very pure corrosive sublimate.

I again adjusted my apparatus, and applied a very moderate heat to it; no more nitrous vapours passed over; the saline matter in the retort was dried up, when a very white salt, in the form of beautiful needles, was sublimed,

sublimed on its surface. As soon as the sublimation appeared to have ceased at that heat, I put out the fire, and broke the retort with great care. It contained at the top and in the neck about 15 grammes of dissolvable salt, possessing all the properties of very pure corrosive sublimate. In the bottom of the retort was a yellowish matter, weighing about 18 grammes: this matter being broken to pieces was introduced into a small phial, which was placed on a sand-bath, and heated for an hour, during which time thick vapours were disengaged from it. The phial being broken, its neck was lined with a saline matter, weighing 18 grains (about 1 gramme): this I discovered to be corrosive sublimate, and when added to what I had before taken off, made a total of 16 grammes 6 decigrammes. The bottom of the retort contained about $3\frac{1}{2}$ gros of very fine red precipitate, the produce of 4 gros 18 grains (16 grammes 8 or 9 decigrammes) of dried nitrate of mercury. Thus an ounce of mild muriate of mercury, treated with two ounces (about 64 grammes) of nitric acid, gave the following result:

	gros	grains
Corrosive muriate of mercury	4	40
Dried nitrate of mercury .	4	18

N. B. The augmentation in the weight of the ounce of saline matter employed is owing on the one hand to the fixed oxygen, and on the other to a portion of nitric acid.

It is easy to account for what occurred in this operation.

The mild mercury employed was a muriate composed of a great quantity of mercury a little oxydated.

The corrosive sublimate obtained is a muriate saturated with oxygen and acid.

The

The former salt must therefore necessarily have passed to the state of the latter, in order to lose part of its own basis to gain that of oxygen.

Hence we see: 1. That the nitric acid employed lost its oxygen, since it gave out red vapours.

2. That it seized a portion of the metal, relatively more considerable in the mild mercury, since it formed nitrate, and afterwards red oxyd of mercury.

3. That the muriatic acid, being obliged to concentrate itself in a less quantity of mercury more highly oxygenated by nitric acid, again formed corrosive sublimate, but only in a quantity proportionable to itself.

What would have been the consequence if this quantity of muriatic acid had been more considerable will be shewn in the following Experiment.

Experiment II. To the two substances employed in the foregoing experiments, I added 1½ ounce of pure muriatic acid, and conducted the operation in the same manner. At first there was a disengagement of vapours of oxygenated muriatic acid, (as is the case when muriatic and nitric acid are mixed together,) and afterwards of very great quantities of nitrous acid vapours. At last 1 ounce 50 grains of very fine oxygenated muriate of mercury was sublimated: at the bottom of the retort I found nothing but a residue of a few grains only.

This experiment appeared interesting to me: 1. Because it accurately determines the action of nitric acid on this muriate of mercury in a manner perfectly new, as M. Fourcroy, the last writer that has treated of it in his "System of Chemical Knowledge," vol. V. p. 351, positively says, when speaking of the mild muriate of mercury, *Nitric acid does not convert it into corrosive sublimate.*

2. Because it may afford a method of obtaining, at one and the same time, and with facility, two very valuable articles,

articles, corrosive sublimate and red precipitate, if mild muriate could be procured by a more economic process than those with which we are yet acquainted.

Action of the Distilled Waters of Plants.

Distilled waters, even those called inodorous, disoxydate the mercury of corrosive sublimate more or less *. This alteration is the more striking because they contain volatile oil in solution.

Experiment I. Five decigrammes of corrosive sublimate, dissolved in distilled water, were poured into four hectogrammes of peppermint, recently prepared. This liquor, left at a temperature of 16 to 20 degrees of the centigrade thermometer, appeared, in a few hours time, like Seine-water, rendered turbid by a heavy rain; and in the space of two or three days it had become clear, but had precipitated a flaky deposit, of a greyish colour, insoluble in hot water, and even in alkohol, (both of

* I use the expression, *disoxydate the mercury of the corrosive sublimate*, instead of *disoxygenate the acid* of that salt, for the following reasons. 1. Corrosive sublimate is reduced, at a high temperature, by alkalis, calcareous earth, &c. in muriatic acid, which combines with those bases in liquid mercury, that become volatile when separate.

2. By the action of mineral acids on that salt, no oxygenated muriatic acid is disengaged.

3. Simple muriatic acid dissolves the red oxyd, (precipitate *per se*), without any disengagement of oxygenated muriatic acid; therefore the acid of this saline substance is not in an oxygenated state, but in that of simple muriatic acid, combined with mercury more oxydated and in smaller proportions than in mild muriate.

This opinion, lately advanced by M. Proust in a memoir inserted in No. 126 of the *Annales de Chimie*, I profess, in common with him; and I had communicated it to several persons, prior to the publication of the memoir of that learned chemist, and had likewise mentioned the necessity of giving that salt the more accurate name of superoxydated muriate of mercury.

them

them being but slightly tinged by the vegetable matter precipitated, at the same time, as the metallic salt), it was insoluble in acids, cold; and was, in short, real muriate of mercury very little oxydated.

The liquor, separated from the deposit, was very clear, and had little smell; it formed no precipitate with lime-water, and only turned a little brown with hydro-sulphuret of ammoniac.

Experiment II. The same experiment was made with the distilled water of lettuce and of borrage: they precipitated mild mercury in two or three days; at the same time continuing to hold the mercurial salt in solution.

Action of Alkohol.

Experiment I. A saturated solution of corrosive sublimate in alkohol was left in a bottle well closed, at the ordinary temperature of the atmosphere, for four months. It had then deposited, in the state of mild mercury, about half the metallic salt it contained. The liquor had acquired a strong smell of ether, and reddened tincture of turnsol.

Experiment II. A like solution was heated till the alkohol was completely, but slowly evaporated: the coloured residue was corrosive sublimate mixed with an eighth part of mild mercury.

Experiment III. A like solution was set on fire; while burning, it emitted a white smoke, which being collected in a paper cone was saline and dissolvable. About half a gramme of mild mercury was left at the bottom of the vessel.

TO BE CONCLUDED IN OUR NEXT.

Intelligence relating to Arts, Manufactures, &c.

Sweeping Chimneys.

A MEETING of the President, Vice-Presidents, &c. of the Society for superseding the necessity of Climbing Boys, by encouraging a new method of sweeping chimneys, and for improving the condition of children and others employed by chimney-sweepers, was recently held at the York-Hospital, Westminster, according to appointment, for the purpose of examining and seeing the several machines worked by the under-mentioned candidates for the premium for sweeping chimneys.

The first machine introduced, was one by Mr. Orme, late an officer in the army, being a brush, curiously constructed, upon the end of an elastic pole, composed of whale-bone, with two projecting wings, made of strong leather; the end of which was lined with steel, to form a scraper. To the pole were superadded various lengths, made of the same materials, and wrapped round with a cord, resembling the handle of a drayman's whip, and so contrived, that by the elasticity of the pole, joined thus together, and suspended from the brush, it took the chimney in all directions. The chimney to the top was forty-five feet high, and in three minutes the machine, thus contrived, completed the operation.

The second was by Mr. Barber. His machine was also fixed upon the end of a pole, being six brushes, forming a sugar-loaf, with a scraper affixed to each brush, being so well contrived, that, when the machine ascended to the top of the chimney, by the smallest touch in pulling a conducting cord, the whole of the brushes spread in their several directions, so as completely to fill the flue and

crevices

crevices of the chimney, with a scraper and brush extended in every direction.—This machine ascended the chimney by the assistance of several pieces of wood, occasionally linked together, at the extremity of each link, which formed an angle, with a caster or roller at each angle. The machine in its experiment, by some accident, broke the chimney-pot, and left the brush at the top; but on the second trial, in a back parlour, it completed the design in five minutes.

The third competitor was a Mr. Griffin. His instrument was formed with a coarse brush, nearly in the same manner as the preceding, with the exception of a spring, and a top brush, which was to fall over the chimney-pot, but by some defect he could not raise the machine.—During this time, Mr. Orme observed a small baking-oven, with a flue to it, and in less than three minutes he, by his above-mentioned machine, completed his experiment, by sending his brush, &c. to the top of the chimney and down again.

The fourth was a Mr. Davis; he began his experiment ten minutes before eleven. His machine was nearly constructed the same as that of Mr. Barber's; forming only four brushes, with a serger affixed immediately before each brush, with inflexible joints, and several pieces of lath-wood, forming an handle; by the addition of these handles, it ascended the chimney, 45 feet, in six minutes, and completed the operation. By our List of Patents last month it will be seen that Mr. Davis has obtained a patent for this invention.

The fifth and last candidate was a Mr. Smart. His machine was a brush forming five squares, upon the end of a hollow pole, through which was a small rope, and was followed by a vast number of short lengths of wood, with a hole

hole and rope through each; at the end of each of those pieces of wood there was a piece of brass, forming a kind of bell, the end of each piece followed in succession, into the groove of each of those bells, so as to make them stationary; and by tightening the rope, which was done by a pully, they became substantial, and yet so pliable as to take the zig-zag of the flue; but, by some mischance, one of the pieces of wood broke; and notwithstanding he had tried the experiment before with success, in this instance he failed.

Durham Agricultural Society.

A society has lately been established called the Society for Experimental Agriculture, in the county of Durham, the objects of which are stated to be:

1. To examine, by experiments, the differents kinds and merits of grass, seeds, and grain; to investigate their habits, and endeavour to ascertain what soils are best adapted to each kind, and to devise means to obtain such seeds, &c. pure.

2. To attend carefully to the rearing of fences, draining of land, and the best and most expeditious way of cleaning and working different soils.

3. To examine the nature of different manures, and ascertain the best mode of applying them.

4. To find what stock is best calculated for certain situations; to compare the relative quantities of food consumed by different kinds of stock; what food is most congenial, &c.

By the rules of this society it is limited to twenty-one members, and it is to meet four times a year at Rushyford. When any member undertakes an experiment adopted by the Society, two members are to be appointed

as visitors to view with him the state of the land previous to the experiment, inspect its progress, and report the result.

The President for the year 1803 is Sir Henry Vane Tempest, Bart.; and two meetings of the society have already been held, on 1st of April and 1st of June.

Spanish Wool.

It has been proved, by his Majesty's Spanish flock, in ten years experience, that the wool of that breed does not degenerate in this country. It is ascertained that the first cross of a new breed gives the lamb half of the ram's blood; that the second gives 75 *per* 100; the third $87\frac{1}{2}$; and the fourth $93\frac{3}{4}$. The difference between the fleece of the original stock and the wool of the mixed breed is then scarcely perceptible, particularly if attention has been bestowed on the selection of the ewes.

Substitute for Soap.

In the eleventh number of the Repertory of Arts, &c. we published Mr. Vancouver's specification of his patent for a method of preparing an earth, found on Lord Warwick's estate, to be used as a substitute for soap, and particularly for cleansing wool. A similar kind of earth, and possessing the same detergent properties, is found in many parts of the Yorkshire Wolds; it is composed of clay, sand, and the oxyd of iron, and it is used for wash-balls. The only difference between them appears to be, that in Warwickshire the earth is of a green, grey, lilac, or white colour, whilst that of Yorkshire is generally of a yellowish-white. The former is held together by a strong size; the latter has hitherto been seldom used in washing linen, as it rapidly dissolves in water, but that defect has been corrected by the mixture of glue.

List

List of Patents for Inventions, &c.

(Continued from Page 80.)

ELIZABETH BELL, of Hampstead, Middlesex, Spinster; for a method of sweeping chimneys, and of constructing them in such a manner as to lessen the danger and inconvenience from fire and smoke. Dated May 10, 1803.

GEORGE BEAUMONT, of South Crossland, near Huddesfield, Yorkshire, and WALTER BEAUMONT, of the same place, Manufacturers of Woollen Goods; for a mixture to be used in the preparation of sheep or lambs wool, for various purposes. Dated May 17, 1803.

JOSHUA GREEN, of Banbury, Oxfordshire, Manufacturer; for a method of manufacturing corded and ribbed shags, or plushes, composed of different materials, on a principle entirely new. Dated May 17, 1803.

JAMES ROCHE, of King-street, Holborn, Middlesex, Gentleman; for a medicine for the cure of the hooping cough. Dated May 23, 1803.

CHESTER GOULD, of Red Lion-street, Clerkenwell, Middlesex; for a glass on a new principle, to be used by mariners at sea, instead of the common sand-glasses when heaving the log, for the purpose of ascertaining the ship's rate of sailing; and also for other uses, either on land or at sea. Dated May 28, 1803.

THOMAS FULCHER, the elder, of Ipswich, Suffolk, Surveyor and Builder; for a water-proof composition, in imitation of Portland-stone, for stuccoing and washing new and old stone, and brick buildings; and for cementing the joints, and tucking and pointing all stone and brick works that require proof against water and damps. Dated May 28, 1803.